

Ninth Annual Review of Activities

Project Resumes

1984

edited by

Barbara M.W. Carroll

Mineral Resources Division
Department of Natural Resources
New Brunswick

1984

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SOUTHERN NEW BRUNSWICK

A.A. Ruitenbergh, Regional Geologist

The Sussex Regional Office staff consists of A.A. Ruitenbergh, Regional Geologist; S.R. McCutcheon, Assistant Regional Geologist; M.R. Mazerolle, Engineering-Technician and Mrs. F.H. Kelly, Administrative Services Officer. T. Pronk was employed by contract to map and sample tills overlying gold-bearing rocks in the Cape Spencer-Black River and Musquash Harbour areas. J.A.R. Sterling of the New Brunswick Research and Productivity Council was engaged on a short term consulting contract to investigate the mineralogy of some prominent gold occurrences. D. Hattie and P. Chiswell were contracted to compile mineral occurrence data for a new metallogenic map of New Brunswick.

Stratigraphic and mineral deposits investigations were continued during the summer field season by S.R. McCutcheon and A.A. Ruitenbergh. L. Long, R. Murphy, R. Poirier and K. Secord were employed as field assistants on the bedrock and surficial geologic surveys.

S.R. McCutcheon measured stratigraphic sections in the Mount Pleasant Caldera early in the field season. The latter part of the season was concentrated on stratigraphic problems in the Lorneville-Lepreau area, southwest of Saint John.

A.A. Ruitenbergh updated and revised the geologic map of the gold-bearing rocks in the Cape Spencer-Black River area, northeast of Saint John. The newly excavated trenches in the Cape Spencer gold deposit and recently discovered rock outcrops to the northeast were examined in detail. A representative set of gold-bearing samples was collected for mineralogical examination. Polished thin sections of these samples were microscopically examined and analyzed with an electron microscope by J.A.R. Sterling.

Gold-bearing arsenopyrite-pyrite rock samples also were collected for probe analysis from the altered zone adjacent to the Lake George Antimony deposit. Samples collected from similar gold deposits in the Southern Uplands of Scotland are also being analyzed for comparison.

Field examinations were done in preparation of tin-tungsten-molybdenum, gold and Windsor Group field guides for the Geological Association of Canada Meeting to be held in Fredericton in May of 1985. These guides will be self-explanatory to facilitate use by geologists not participating in organized field trips.

A field trip to the gold-bearing rocks in the Bay of Fundy area and the Annidale Copper Prospect was provided for recent graduates of the prospecting course sponsored by the Geological Survey Branch. Other field trips were given for mineral deposit geologists from other provinces and the United States. S. R. McCutcheon attended a field trip, sponsored by Dalhousie University, to volcanic terrains in California. A. A. Ruitenberg participated in a geologic conference and associated two-week field trip sponsored by I.G.C.P. and NATO, in the pre-Carboniferous rocks of Wales, England and Scotland.

Papers on the geology of gold deposits in southern New Brunswick and application of geology to forest site classification were given by A.A. Ruitenberg at the 1984 Geological Association of Canada meeting in London, Ontario. A poster session on gold and other metallic mineral deposits in southern New Brunswick was also given at the Annual Meeting of the Prospectors and Developers Association in Toronto.

GEOLOGY OF THE GOLD BEARING ROCKS IN THE LORNEVILLE-LEPREAU AREA

A number of gold showings have been found in recent years between Musquash and Dipper Harbours along the Bay of Fundy coast west of Saint John. In order to ascertain the geologic setting of these gold occurrences, a stratigraphic investigation was conducted in the area (Fig. 1) during the past summer. The program was undertaken because the existing geologic maps indicated that there were conflicting views about the age of the rocks and the gold mineralization. As a result of this mapping a number of Windsor Group outcrop localities were found that help resolve much of the age controversy. The following are brief descriptions of the rock units shown on the map.

Unit 1: Green Head Group rocks consist of bluish grey to white crystalline carbonates, grey quartzites and minor dark grey slate. However, the Green Head north of Ludgate Lake contains practically no carbonate rocks. The Group is intruded by granitoid rocks of Unit 3 and by numerous mafic dykes. Compared to the Windsor limestones, the Green Head carbonates are generally more cystalline, have abundant calcite veinlets and are intruded by dykes.

Unit 2: This unit comprises three distinct subunits but all are unconformably overlain by Carboniferous rocks and are, lithologically, most like the Precambrian Coldbrook Group. Previously, most of these rocks were included in the "Mispeck Group", now abandoned.

Unit 2a is best developed in the eastern part of the map area but also occurs at Gooseberry Cove and Chance Harbour. It consists of dark green to purple mafic flows and hyaloclastites.

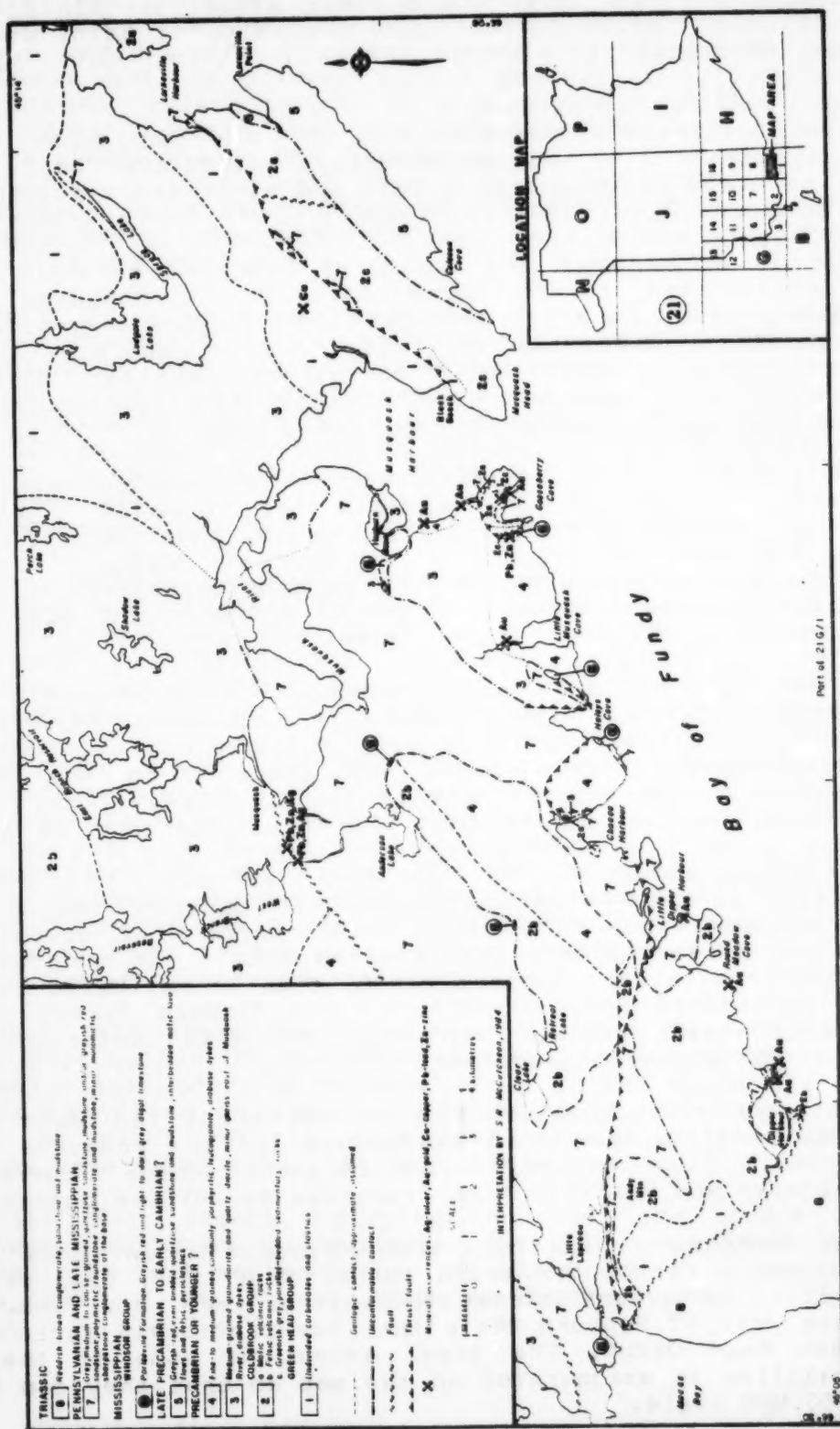


Fig. 1. Geology of gold-bearing rocks, Lorneville-Lepreau area

At Lorneville Harbour, pillow lavas and pillow breccias are present locally in this unit. These rocks almost certainly are equivalent to the "Carboniferous" pillow-basalts at Saint John, which were described by Strong et al. (1979, CJES, pp. 1071-1085).

Unit 2b is in the western part of the map area and predominantly consists of white-weathering "quartz-eye" tuff. It also contains greenish grey lithic tuff and minor mafic volcanic rocks in places.

Unit 2c is found near the mouth of Musquash Harbour and extends northeastward toward Lorneville. It is composed of greenish grey, even, parallel-bedded, fine- to coarse-grained, quartzose sandstone and slate. Bed thickness is generally less than 30 cm but locally it is over 1 m. The even-parallel bedding and absence of very coarse-grained lithofacies distinguishes these rocks from the Carboniferous grey beds.

Unit 3: This unit is lithologically heterogeneous even at outcrop scale, but mostly consists of greenish grey, medium-grained granodiorite and quartz-diorite. That part of the unit north and west of the dotted contact at Musquash River appears to be more pristine and may be younger than that to the east - respectively equivalent to Units 13 and 8 on the maps of Ruitenberg et al. (1975).

Unit 4: Fine- to medium-grained leucogranite is characteristic of this unit and it commonly contains "quartz-eyes". In places it has a very fine-grained groundmass suggesting hypabyssal emplacement, and there is a distinct possibility that it is comagmatic with the "quartz-eye" tuff of Unit 2b. It is equivalent to Unit 16a of Ruitenberg et al. (1975).

Unit 5: This unit also was previously part of the, now abandoned, Mispeck Group. The lower part consists of greenish red, fine- to medium-grained, quartzose sandstone and mudstone. Beds are even-parallel and generally less than 30 cm. Mafic lava flows are interbedded and, locally, so are diabase dykes. The upper part contains felsic pyroclastics with interbedded greenish grey sandstone and mudstone.

This unit is distinguished from Carboniferous red beds by even-parallel bedding, quartzose sandstones and the presence of diabase dykes. Fine-grained Carboniferous redbeds contain abundant feldspar and volcanic rock fragments as well as quartz.

Unit 6: Previously, the only known Windsor Group rocks in the map area were at Hepburn Basin (McCutcheon 1981, Open File Report 81-31). Seven additional localities are now known, including one west of Hepburn Basin that was previously included in the Green Head Group. The areal extent of some of these Windsor localities is exaggerated on the map so that they can be shown at 1:50,000 scale.

The Windsor rocks, which are assigned to the Parleeville Formation (McCutcheon 1981), mostly consist of grey to red, locally fossiliferous, algal boundstone. This boundstone always unconformably overlies pre-Carboniferous rocks. Along strike, it changes rapidly in thickness from several metres to a few decametres and, in places, is not present at all. By corollary with Windsor strata in the Moncton Subbasin farther northeast, these rocks indicate that the Carboniferous section in the map area is middle Viséan and younger in age.

Windsor rocks are distinguished from the Green Head because of their association with redbeds, less crystalline nature and absence of mafic dykes.

Unit 7: The lower part of this unit is predominantly redbeds (Hopewell Group equivalent) and the upper part is predominantly grey beds (Lancaster Formation), but in places there are grey rocks at the base of the section and red rocks in the upper part. Therefore, the section is not readily divisible into two map units at 1:50,000 scale, although most of the belt between Lepreau and Musquash consists of Lancaster grey beds. The rocks south of this belt were previously included in the Mispeck Group.

The redbeds generally coarsen upward. The lower part is thin- to medium-bedded, fine- to coarse-grained sandstone and mudstone, whereas, the upper part contains abundant pebbly sandstone and pebble to cobble conglomerate with lesser mudstone. Well-rounded quartzite clasts are common in the conglomerate, and calcite is present in the mudstone in places.

In one outcrop on the east side of Dipper Harbour a sedimentary breccia, at the base of the redbed sequence, is unconformable on felsic volcanics. It consists of white-weathering, felsic volcanic clasts in a white groundmass of comminuted volcanic material. Red sandstone lenses in this highly deformed breccia give the false appearance that redbeds are interbedded with felsic volcanics. Similar sedimentary breccia is found at the base of the section east of Retreat Lake and southeast of Andy Mountain.

This unit spans the time interval from late Viséan to at least Westphalian C. The lower limit is given by the fact that it conformably overlies Windsor Group rocks, which are known to be middle Viséan in age (McCutcheon 1981). The upper limit is given by plant fossils that were recovered from the Little Lepreau area (oral comm., N. Rast 1984).

Unit 8: Steeply dipping redbeds are found in the southwest corner of the map area. Detailed information about the stratigraphy and sedimentology of these rocks can be found in Nadon (1981, M. Sc. Thesis, McMaster University).

Structure: The post-Carboniferous structure in the map area is strongly influenced by the "coastal thrust belt", a zone of thrust faulting extending from Maces Bay eastward toward Musquash Harbour, thence northeastward toward Lorneville Harbour. This belt includes the Saint John and some of the Chance Harbour Nappe Complexes of Rast et al. (1978, NEIGC Guidebook, pp. 162-173). To the north away from this belt, only one episode of cleavage folding can be observed, but in the vicinity of the belt, two cleavages are commonly present. In at least two localities where gently dipping second cleavage is well-developed, one on the east side of Chance Harbour and the other on the east side of Haleys Cove, it is coplanar with nearby thrust faults. Gently dipping second cleavage is also dominant at Dipper Harbour but no obvious thrust is seen.

Where second folds are not developed, first folds are northerly to easterly trending and overturned northward with a gently dipping axial surface cleavage. Major folds characteristically have steep to overturned northern limbs and upright, gently dipping southern limbs. Pre-Carboniferous rocks are involved in this folding because there are several examples of upside-down unconformities with both massive volcanic and granitic rocks overlying Carboniferous clastics. How these unconformities became overturned is not clear because the known thrust faults apparently are not situated such that could have produced them.

The post-Carboniferous penetrative deformation in the map-area probably resulted from movement on the east-west trending Cobequid-Chedabucto Fault system, which terminates off the south coast of New Brunswick. In Nova Scotia, several kilometres of post-Devonian strike-slip offset have been documented on this fault zone (Donohoe and Wallace 1980, GAC-MAC Annual Meeting, Field trip 19). It is postulated that this strike-slip offset was accommodated by thrust movement near the terminus of the fault in southern New Brunswick.

Mineralization: All except one of the gold showings west of Saint John are in probable Precambrian rocks. The exception is the showing at Little Dipper Harbour which is in quartz veins cutting Carboniferous redbeds. In addition to the showings, anomalous gold values from silt, pan concentrate, and rock chip samples were reported from the granitic terrain west of Musquash Harbour by Rex Silver Mines (1984, Assessment Files).

The general absence of anomalous gold values in the Carboniferous strata suggests a pre-Carboniferous age for much of the mineralization. However, the showing at Little Dipper Harbour indicates remobilization has occurred. This is also indicated by the unconformity related mineralization in the Cape Spencer-Millican Lake area east of Saint John. Therefore, one obvious target for careful exploration in the map area is the unconformable contact between the Carboniferous and pre-Carboniferous terrain.

THE MOUNT PLEASANT CALDERA

Work is still in progress on the caldera rocks. This year type sections for the major rock units were measured and samples were sent away for whole rock and trace element chemistry. Also a test batch of samples is being processed for oxygen isotopes to see if it is worthwhile investigating alteration zones by this technique.

Next year, microprobe studies on phenocryst phases and an age dating program using the Ar 39/40 step-heating method will be done. A final report will follow upon completion of the work.

GEOLOGY AND MINERALOGY OF GOLD DEPOSITS IN THE CAPE SPENCER-BLACK RIVER AREA

The objective of this project is to:

1. establish the relationship of gold deposits and occurrences to the regional stratigraphy and structure.
2. establish the grain size and shape of gold grains and their relationship to metallic sulphide minerals and rock alteration.
3. determine the distribution of gold in the map-area by:
 - (a) analyzing glacial tills for gold and accompanying elements and
 - (b) determining the displacement of the tills from their bedrock source by investigating glacial striae, till fabrics, and lithologic compositions.

Bedrock Geology: Detailed examination of the newly excavated trenches at Cape Spencer and recently discovered outcrops in the area between Cape Spencer and Black River resulted in revision of previous geologic maps. These revisions are summarized in figures 2 and 3.

The oldest rocks in the Cape Spencer-Black River area are intensely deformed, grey and greenish grey, thinly bedded, siliceous siltstone and sandstone, conglomerate and basalt of probable late Precambrian or early Cambrian age (Unit 1, Fig. 2). These rocks occupy most of the coastal area between Cape Spencer and Black River.

Unit 1 is intruded by, and is in faulted contact with, a body composed of variably altered, medium-grained granodiorite and granite that extends from Cape Spencer northeastward across the Black River. In the Black River area, these rocks were previously dated as Carboniferous (Ruitenberg 1970, Report of Investigation No. 13), but this date probably reflects a metamorphic event, because the intrusion is unconformably overlain by Carboniferous rocks (Unit 4).

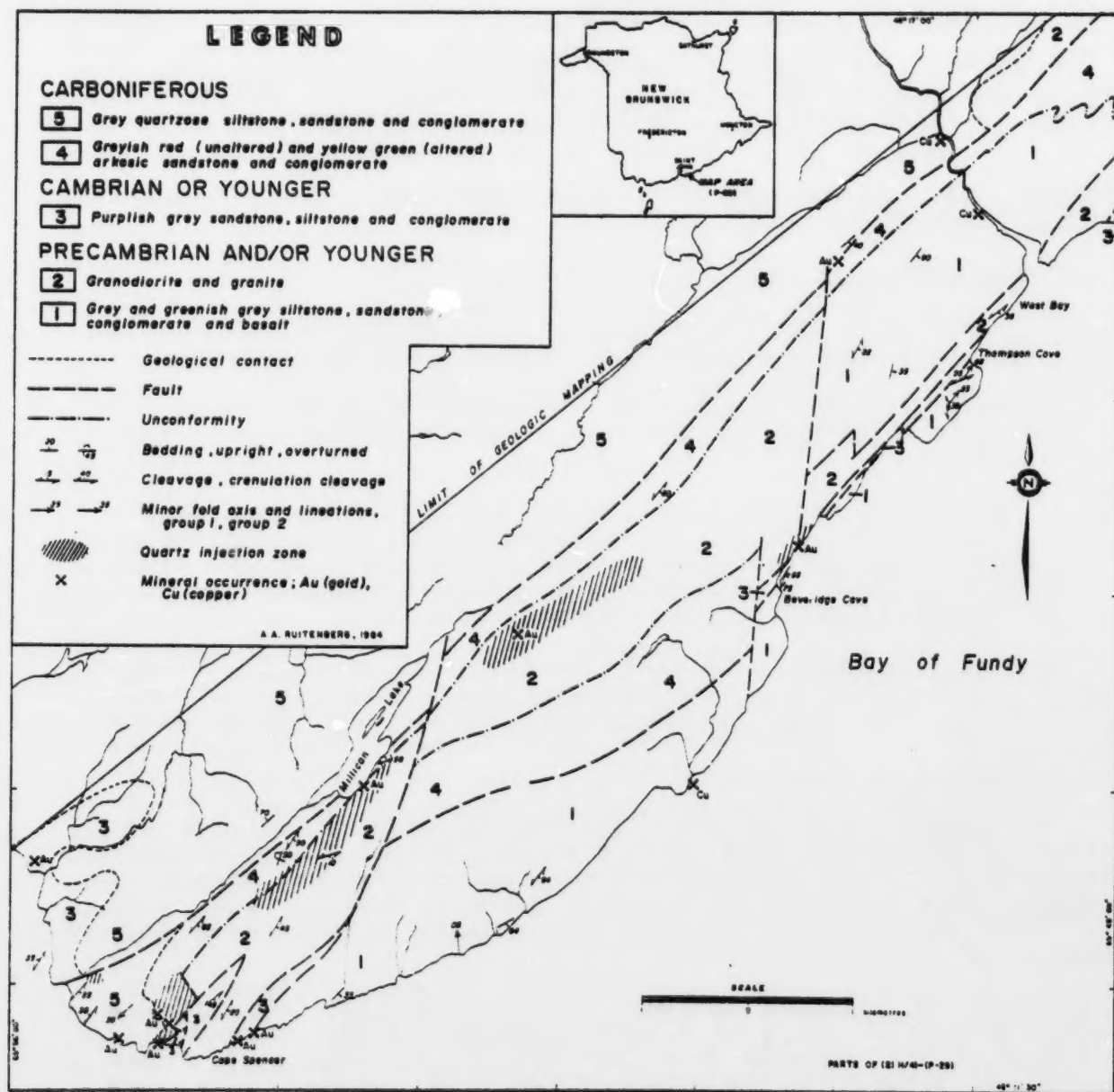


Fig. 2. Geology of gold-bearing rocks, Cape Spencer-Black River area

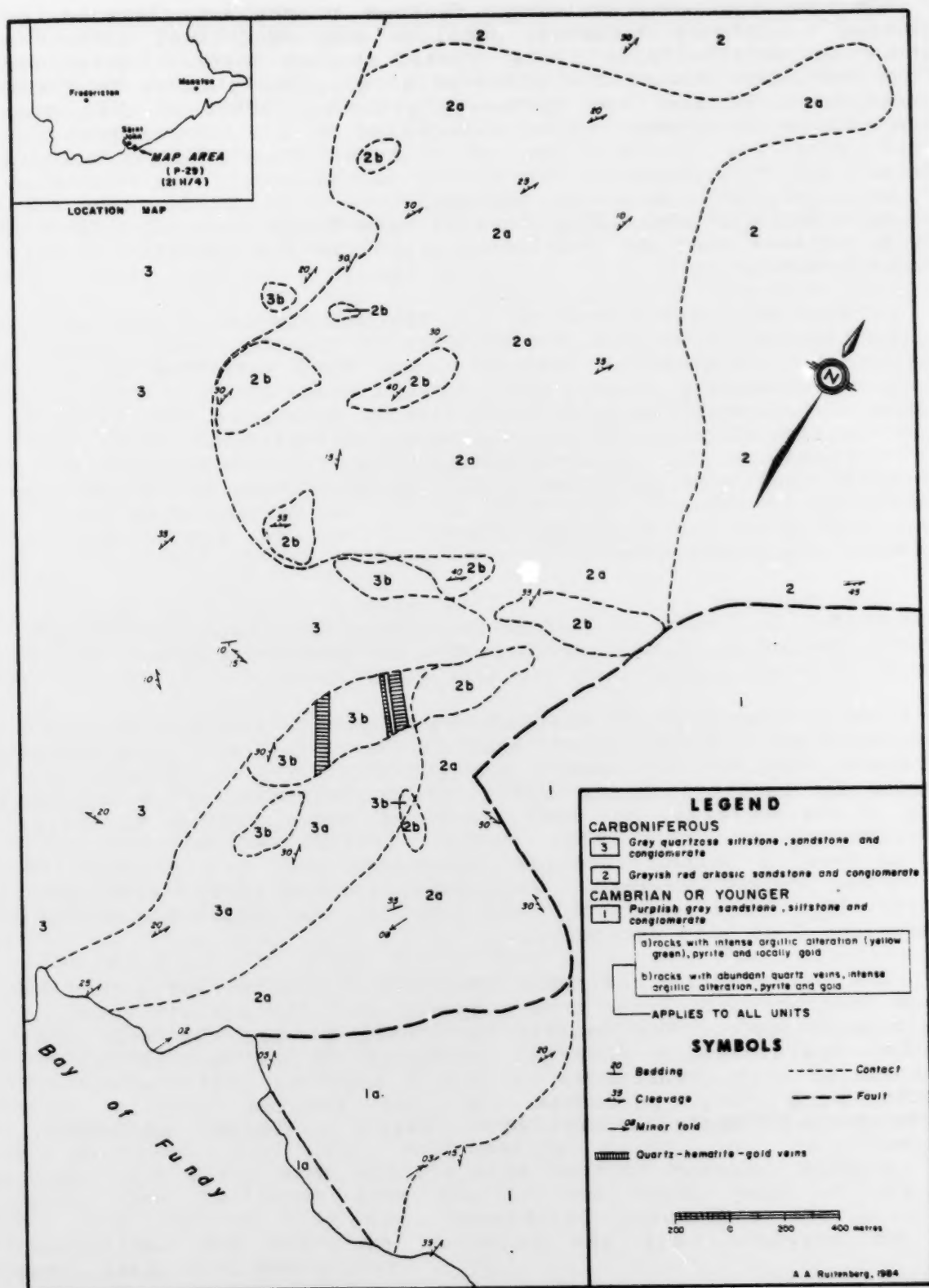


Fig. 3. Geology, Cape Spencer gold deposit

Narrow northeast-striking, faulted blocks of Cambrian or younger, intensely deformed, purplish grey sandstone, siltstone and conglomerate (Unit 3) are exposed at Cape Spencer, Beveridge Cove and Black River. The presence of granitic pebbles in these rocks north of the Cape Spencer lighthouse indicates that they are younger than the intrusive rocks of Unit 2. It is possible that they are correlatives of Cambrian strata described by McLeod and McCutcheon in the Little Salmon River area (Canadian Journal of Earth Sciences 18, pp. 1012-1017, 1981), but they could also be younger. The rocks of Unit 3 are commonly affected by argillic alteration (yellowish green) in the vicinity of gold occurrences.

The granitoid rocks of Unit 2 are unconformably overlain by Carboniferous, intensely deformed, greyish red arkosic sandstone, conglomerate and siltstone (Unit 4). The rocks of Unit 4 are mostly steeply dipping and overturned to the north along the northern margin of the granite intrusion, whereas they are gently dipping along the southern margin. Unit 4 is interpreted to be Carboniferous, because bedding attitudes suggest that it is conformable with rocks of Unit 5. In the Cape Spencer gold deposit, Unit 4 is in faulted contact with Units 2 and 3. Most of the rocks of Unit 4 in this area are affected by intense argillic alteration.

The youngest rocks in the Cape Spencer-Black River area are Carboniferous, intensely deformed, grey quartzose siltstone, sandstone and conglomerate (Unit 5). Carboniferous plant fossils occur in these rocks along the East Black River.

The sedimentary and most of the intrusive rocks in the Cape Spencer-Black River area show a well-defined penetrative cleavage (S_1) mostly subparallel but locally at a considerable angle to bedding. Minor folds (F_1) associated with S_1 are few in the map-area, but they are quite common farther northeast (Ruitenberg et al. 1979, Memoir 1, pp. 84-97). In some localities, a second cleavage (S_2), mostly at a high angle to S_1 , has been observed. Prominent southeasterly overturned folds (F_2) are associated with S_2 in the Cape Spencer and Beveridge Cove gold prospects.

The distribution of gold deposits and occurrences in the Cape Spencer-Black River area suggests that the arkosic rocks of Unit 4, close to the contact with Unit 5, are the main host rocks. The intensity of argillic alteration and quartz veining associated with occurrences in Unit 4 suggests that the arkosic rocks were very permeable for and reacted readily with hydrothermal fluids that gave rise to gold deposition.

The fine-grained rocks of Unit 5 appear to have impounded the ore-forming fluids because of low permeability. It is also possible that pyritiferous fossil plant material in Unit 5 contributed to chemical precipitation of gold from ore forming fluids. It is notable that there are gold occurrences also within rock units 2, 3 and 5, but they appear to be less extensive than those in Unit 4.

In addition to stratigraphic controls, structure played an important role in the concentration of gold. Gold-bearing veins are more abundant and argillic alteration is very intense in areas where bedding (S_0) and cleavage (S_1) are deformed by F_2 folds. Folding of the S_1 cleavage greatly increased the total volume of channelways for ore-forming fluids. The effects are clearly displayed in coastal mineralized sections at Cape Spencer and Beveridge Cove. Detailed mapping during the summer's field season also showed that the more prominent gold occurrences are in close proximity to north-northeast striking (mostly $10^\circ - 30^\circ$) faults. In the Cape Spencer prospect, they are low angle thrusts, but they dip more steeply in the gold prospects to the northeast. Field evidence suggests that these faults were active prior to, during, and to a lesser extent after emplacement of the deposits. Northwest striking faults also occur near the prospects, but their importance is less obvious.

Mineralogy: Polished thin sections of selected samples from the Cape Spencer deposit were microscopically examined with transmitted and reflected light.

Most of the gold is restricted to the sheared and altered groundmass of the arkose and occurs as fracture fillings in pyrite. It also occurs as inclusions within pyrite crystals and as supergene gold. Only one grain of gold was observed in quartz.

The pyrite associated with the gold is usually poikiloblastic and has overgrown the schistosity defined by illite. Pyrite has small inclusions of other sulphides, which are commonly too small for optical identification.

The size of 213 gold grains was measured. The resulting grain size distribution is shown in figure 4.

The alteration minerals associated with the Cape Spencer deposit were identified by X-ray diffraction as illite and kutnahorite.

Surficial Geology: A till sampling and mapping program was conducted over the gold-bearing rocks in the Cape Spencer-Black River area and the area west of Musquash Harbour. Samples were collected from the A- and upper part of the B-horizons because they were considered favourable for gold accumulation. The B-horizon material was also analyzed for copper, lead, zinc and silver.

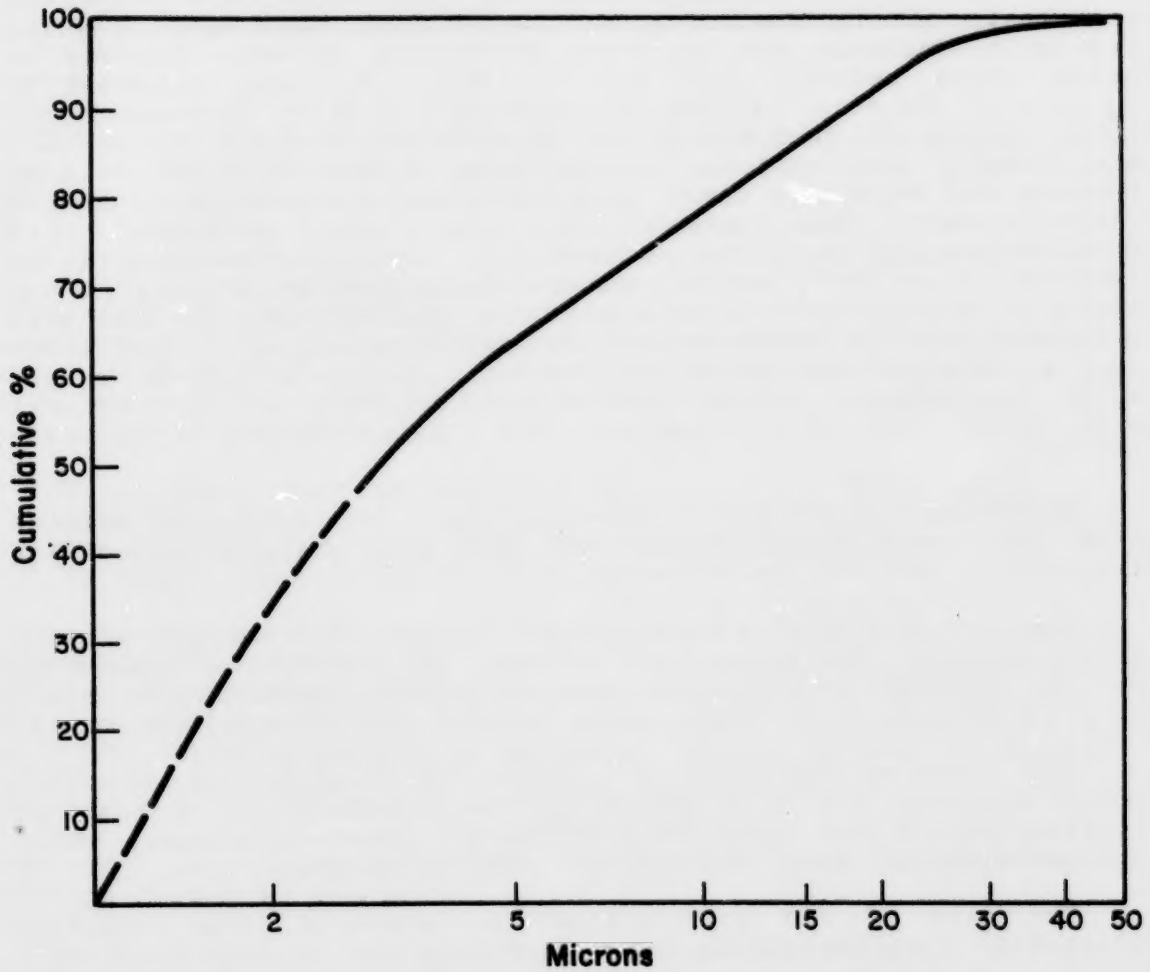


Figure 4. Minimum grain size distribution of 213 gold grains from the Cape Spencer deposit.

In order to determine the displacement of tills from their bedrock source, glacial striae, till compositions and fabrics were investigated. Till compositions were established by determining the percentages of material derived from different bedrock units in the area. This combination of methods facilitates relatively accurate estimates of metallic element anomaly displacements from their bedrock source. These maps have also been proven to be useful to predict forest growth potential (van Groenewoud and Ruitenberg 1982, Maritime Forest Research Centre, Report MX-136).

Most of the Cape Spencer-Black River area is covered by a basal till sheet commonly less than 1 m thick, that was deposited by ice moving in 135° - 160° direction (fig. 5). In a later stage ice movement might have changed locally to 180° - 190° . In some parts of the area the till is reworked by wave action (Units B, Bs and Ww).

Till Unit Tb 5, 6, in the northern part of the map-area contains pebbles and boulders derived from bedrock Unit 5 (fig. 2) and the Balls Lake Formation (north of the map-area) in a red clayey matrix which causes poor drainage in the area. The top of this till is altered by soil-forming processes, which rendered it to be looser than the parent material. Towards the top of the bedrock ridge composed of Unit 4 (fig. 2) the till thins out due to sedimentary reworking. South of this bedrock ridge, granite becomes the dominant component of the till and as a result it is stoney and in places bouldery. In the southern part of the map-area, material derived from bedrock Unit 1 predominates.

Unit Tb 5, 6 has an unusually high clay content, is in places well-bedded near the top and occurs only in relatively low-lying areas. At Chance Harbour, 200 m east from Highway 790, the clayey till unit wedges out to the north into an underlying wave washed, sandy till containing little or no clay. This suggests the possibility of early marine transgression coinciding with the final melting of the glaciers in this area.

In a later phase of deglaciation, peat started to grow on poorly-drained areas. Peat reached a maximum thickness of 5 m northwest of Millican Lake.

The present smooth undulating landscape resulted from post-Pleistocene erosion. Man made his impact on the landscape by removing coarse components and vegetation from the coastal areas, thus promoting erosion in these localities.

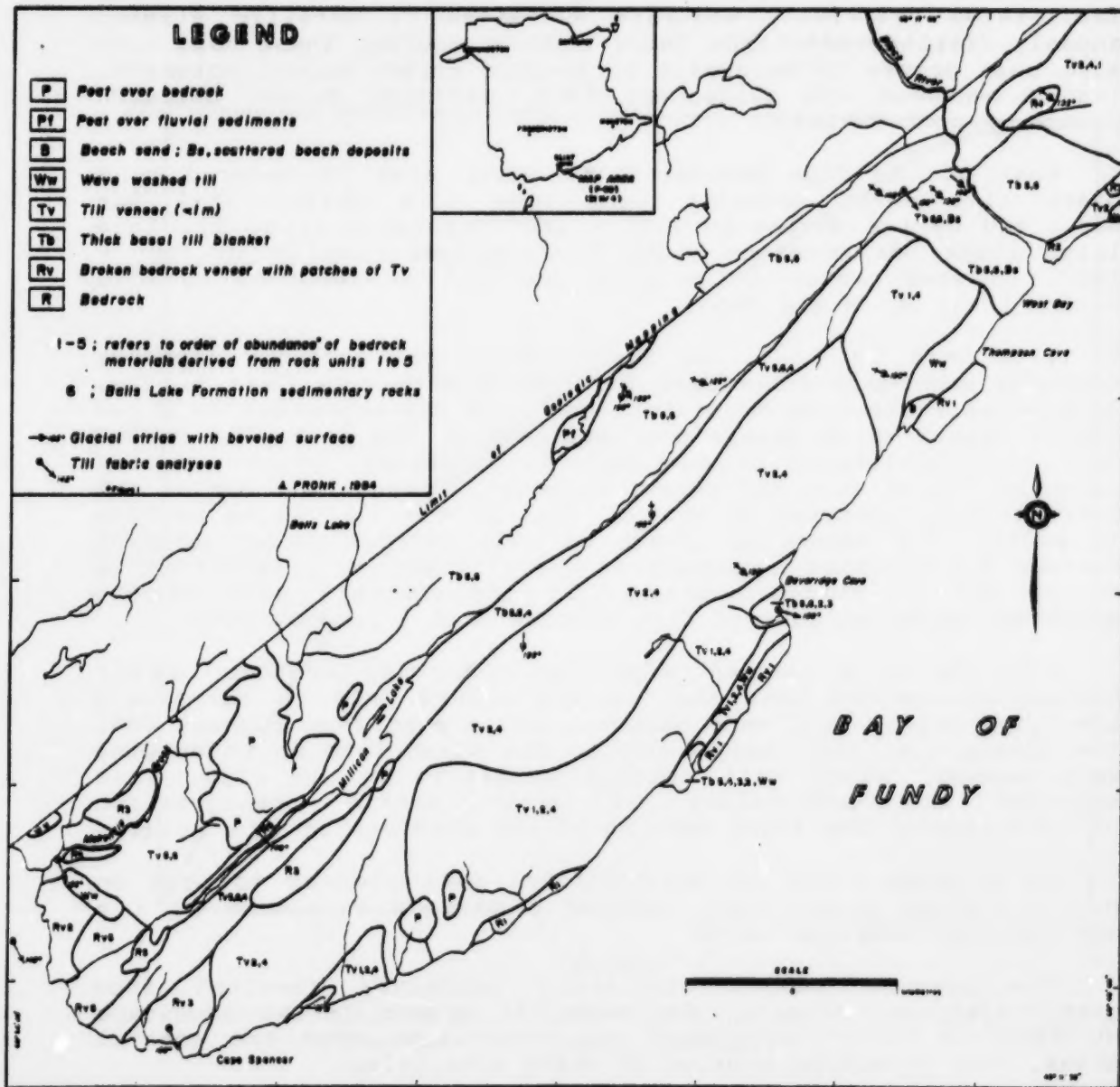


Fig. 5. Surficial geology, Cape Spencer-Black River area

PUBLICATIONS

- McCutcheon, S.R. and Ruitenberg, A.A. 1984. Saint John, Annidale-Nerepis Area. New Brunswick Department of Natural Resources and Canada Department of Regional Economic Expansion, Plate 84-1. Scale: 1:50,000.
- McCutcheon, S.R. and Ruitenberg, A.A. 1984. Hampstead, Annidale-Nerepis Area. New Brunswick Department of Natural Resources and Canada Department of Regional Economic Expansion, Plate 84-2. Scale: 1:50,000.
- McCutcheon, S.R. and Ruitenberg, A.A. 1984. Codys, Annidale-Nerepis Area. New Brunswick Department of Natural Resources and Canada Department of Regional Economic Expansion, Plate 84-3. Scale: 1:50,000.
- McCutcheon, S.R. and Ruitenberg, A.A. 1984. Sussex, Annidale-Nerepis Area. New Brunswick Department of Natural Resources and Canada Department of Regional Economic Expansion, Plate 84-4. Scale: 1:50,000.
- McCutcheon, S.R. 1984. Geologic Sections - Annidale-Nerepis Area, to accompany Annidale-Nerepis Area geologic maps. New Brunswick Department of Natural Resources and Canada Department of Regional Economic Expansion. Scale: 1:50,000.
- McCutcheon, S.R. 1984. A dissected Mississippian Caldera in southwestern New Brunswick. Abstract, Atlantic Geoscience Society Annual Meeting, p. 23.
- Ruitenberg, A.A. 1984. Gold-bearing structures in the Bay of Fundy coastal zone of southern New Brunswick. Abstract, Geological Association of Canada Annual Meeting, London, Ontario, p. 101.
- Ruitenberg, A.A. and McCutcheon, S.R. 1984. Soil geology and forest productivity in New Brunswick. Abstract, Geological Association of Canada Annual Meeting, London, Ontario, p. 101.
- Ruitenberg, A.A., McCutcheon, S.R. and Thibault, J.. 1984. Field guide to geomorphologic districts and regolith systems in New Brunswick. In Preliminary Field Guide to Forest Site Classification in New Brunswick. N.B. Forest Site Classification Council, p. 2.1-2.14 and 3.1-3.19.

NORTHERN NEW BRUNSWICK**J.L. Davies, Regional Geologist**

The Bathurst Regional Office, located at 495 Riverside Drive, is staffed by J.L. Davies, Regional Geologist; J.A. MacIntosh, Assistant Regional Geologist; Sharon McKinnon, Administrative Officer; Maurice Belland, Technician; and André LeBlanc, Technician.

The activities and projects associated with the Regional Office (Fig. 6) are described on the following pages.

Bedrock Geological Mapping

Bedrock geological mapping was carried out in two areas in 1984.

(1) O-9 map area (scale 1" = 1/4 mile) by J.A. MacIntosh.

The O-9 map area is underlain by three metavolcanic-metasedimentary assemblages (Owsiacki, 1980). The oldest, occurring south of the Heath Steele Mine, comprises rhyolite, basalt, agglomerate and breccia which may represent a vent facies rock. The overlying Heath Steele Mine sequence, comprising quartz and quartz feldspar porphyry, banded argillite and siltstone, iron formation and massive sulphides, represent an earlier volcanic episode or a distal facies of the older sequence.

The 1984 field work, which completed the mapping, was carried out in the northwest and northeast corners of the map area (Fig. 7). The O-9 map area is scheduled for publication in 1985.

(2) Nepisiguit Falls (21 P/5) (scale: 1:50,000) by J.L. Davies.

Regional Stream Silt Survey

In 1984, stream silt samples were collected from the east half of the California Lake (21 O/8) map area. Several sulphide deposits occur in this region, including Heath Steele. The results of the survey, carried out by Three-D GeoConsultants Limited, will be released in 1985.

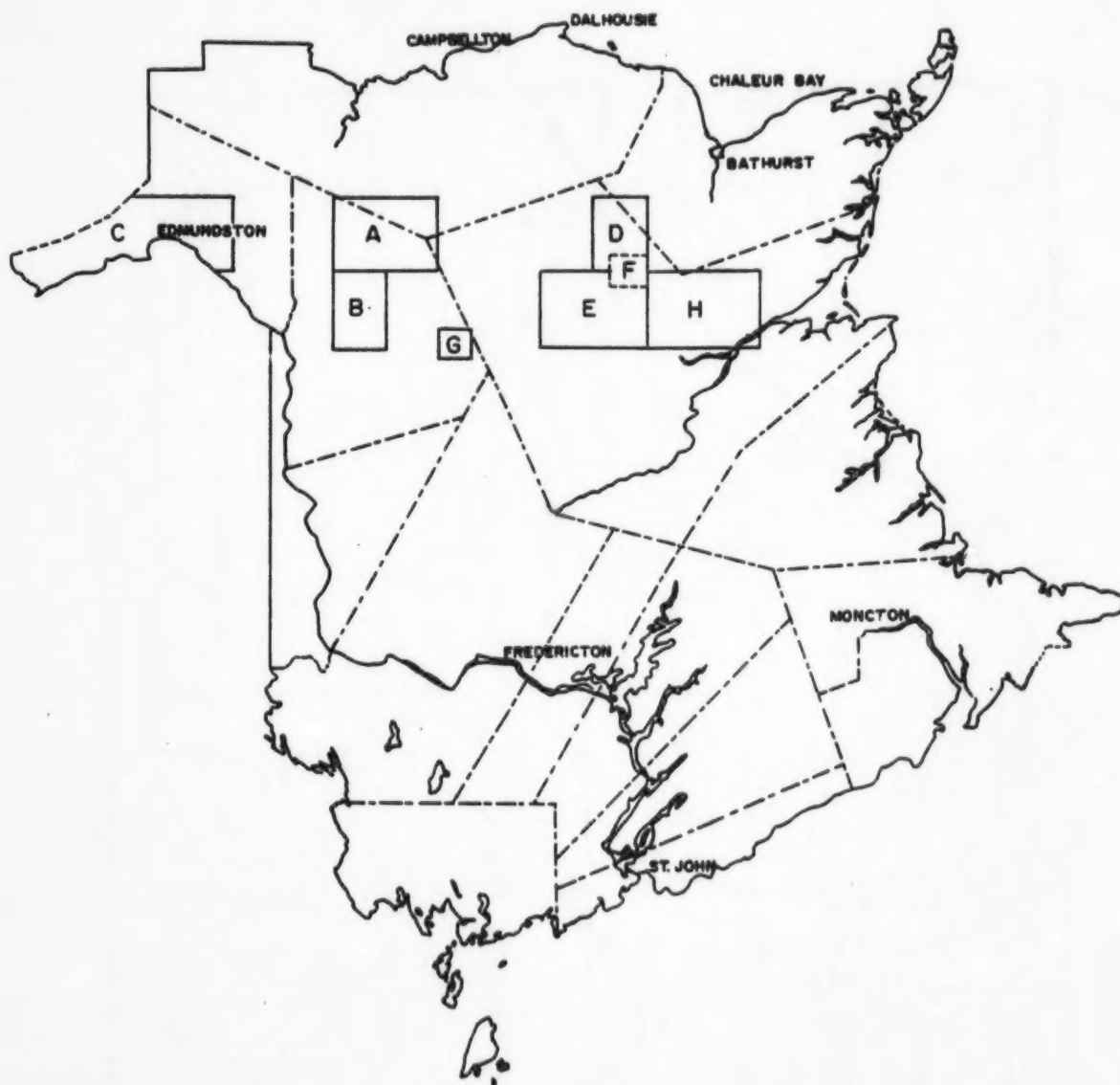


Figure 6. Geoscience projects in northern New Brunswick, 1984. A - Sisson (21 O/6) stream silt geochemical survey results released in 1984; B - Riley Brook (21 O/5W) stream silt geochemical survey released in 1984; C - Parts of 21 N/2, 6, 7 and 8 stream silt geochemical survey, sampled 1983, results to be released in 1985; D - California Lake (21 O/8E) stream silt survey, 1984; E - Big Bald Mountain, 21 O/1 (1:50,000). Bedrock geological mapping by R. R. Irrinki, report and map in preparation; F - O-9 map area (1:15,840). Bedrock geological mapping by J. A. Macintosh, completed in 1984; G - Long Lake-Trousers Lake area (1:25,000). Bedrock, surficial, geological mapping, and till geochemical sampling by A. Pronk and L. R. Fyffe. Maps released in 1984, report in preparation; H - Nepisiguit Falls (21 P/5) geological compilation by J. L. Davies.

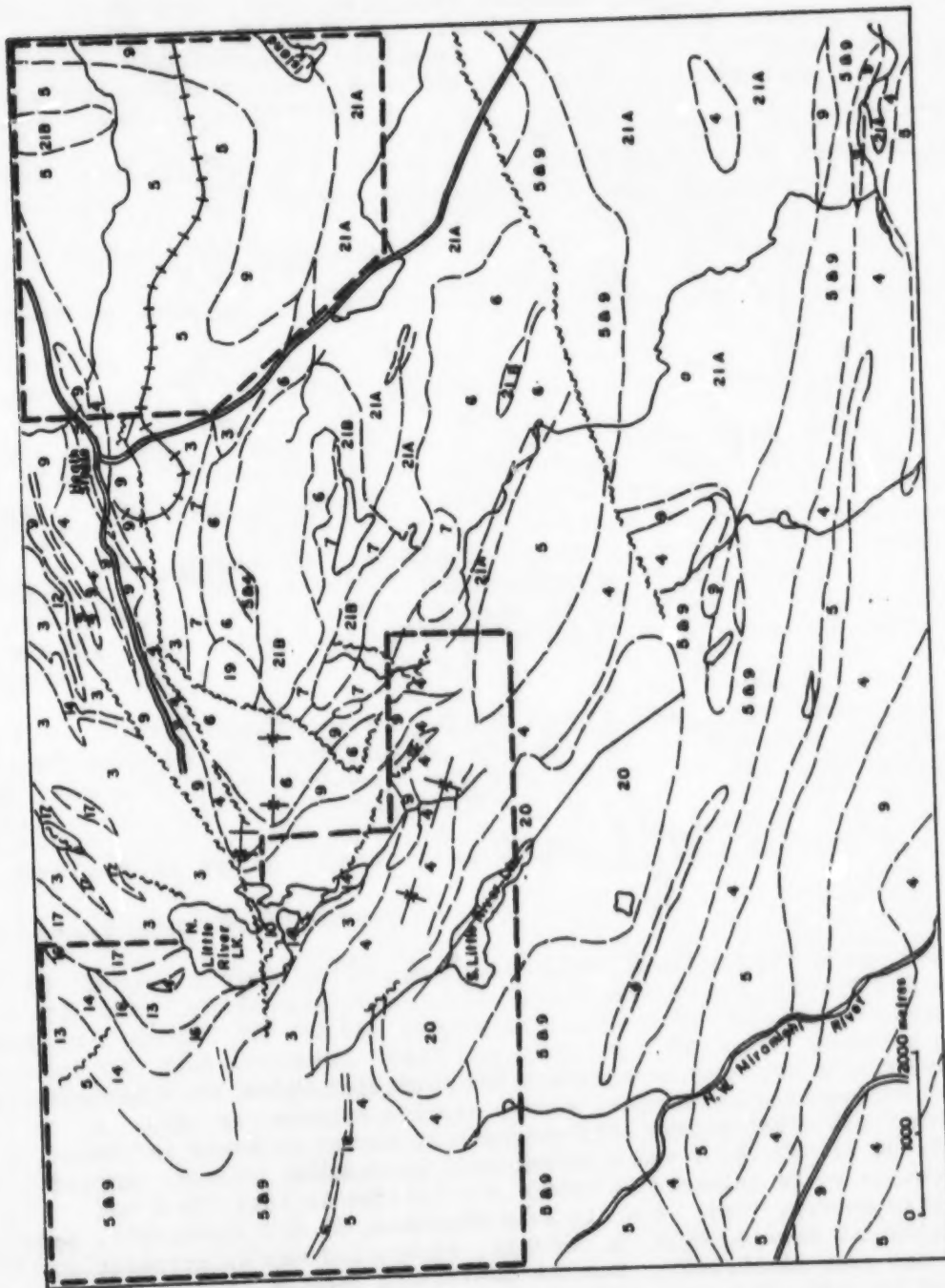


Figure 7. Geology of map-area 0-9 (geological mapping 1984)

LEGEND

TETAGOUCHE GROUP

21B Metagabbro

21A Metabasalt

20 Metagranodiorite

19 Feldspar-quartz metaporphyr

17 Lapilli breccia, siliceous

16 Dacitic feldspar, crystal tuff

14 Lapilli breccia

13 Porphyritic metarhyolite

12 Phyodacite

11 Laminated tuff

9 Quartz-feldspar tuff

8 Andesite lapilli tuff

7 Massive potassic metarhyolite

6 Vent facies breccia

5 Felsic volcanic rocks

4 Metasedimentary rocks

3 Feldspar crystal tuff

2 Chloritic tuff-breccia

Geological boundary

Folds (axial plane trace)

Fault

Outline of area mapped in 1984
(upper left and right corners)

The results of the stream silt survey in northwest New Brunswick (parts of 21 N/2, 21 N/6, 21 N/7, and 21 N/8) were not published in 1984 as scheduled, due to a delay in producing suitable base maps. However, the stream silt geochemical data for the Sisson (21 O/6) and Riley Brook (21 O/3 west) areas were released in early summer. A widespread and as yet unexplained nickel anomaly was outlined. The geological map covering the Sisson (21 O/6) map area by R.R. Irrinki and G. Crouse was also released in 1984.

GAC Guidebook for the Bathurst-Newcastle District

The Regional Geologist has been asked by the Mineral Deposits Section of the Geological Association of Canada to produce a comprehensive guidebook for the Bathurst-Newcastle district. The guidebook will include an up to date account of the geology of the region, descriptions of the most important zinc-lead-silver-copper sulphide deposits, as well as the history of the camp, exploration case histories, extensive road logs, and a comprehensive bibliography. Field work related to this project was carried out in 1984; however, one additional season may be required to finish the task. The Bathurst-Newcastle guidebook will be the second in the series of publications planned by the GAC Mineral Deposits Section.

Mineral Deposits Project

A project was launched in 1984, to obtain all data relating to significant Zn-Pb-Ag-Cu sulphide deposits in the region. Most companies have agreed to co-operate in this effort. R.R. Irrinki and G. Crouse began the project with a compilation of data from the Cominco-Stratmat deposits (see page 22).

Drill Hole Storage

As mentioned last year, the newly built Madran core storage building is now full. During 1984 Brunswick Mining and Smelting Corporation decided to discard most of their diamond drill core obtained from the now exhausted No. 6 sulphide deposit. Mineral Resources Division was able to obtain approximately 20,000 feet and it is hoped that racks will be built to store this core.

Other Activities

The Bathurst Regional Office assisted UNB graduate student Karen Kettles in her study of the Turgeon (Heron Mines) sulphide deposit, a small Cyprus-type pyritic zinc-copper

sulphide deposit hosted by altered and metamorphosed pillowed and/or amygdaloidal basaltic lavas and tuffs overlain by metasedimentary rocks.

Maurice Belland continued his compilation of assessment work, concentrating in 1984 on the areas surrounding the Brunswick No. 6-Heath Steele area, and the Restigouche-Murray Brook sulphide deposits.

André LeBlanc completed the drafting of several maps locating the diamond drill core stored at the Bathurst Regional Office. He also completed the transfer of claims and mining licences to new 1:50,000 base maps.

The initial moves have been made to construct a mining museum at Petit Rocher. J.L. Davies and J.A. MacIntosh expect to be deeply involved with this project in 1985. J.L. Davies also serves as the Mineral Resources Division representative on the technical advisory committee associated with Enhanced Recovery Systems, who will begin testing the SRL process at their Chatham pilot plant in April 1985.

Terry Mersereau was contracted in 1983-84 to investigate the ways and means of initiating the compilation of geoscience data in northern New Brunswick. Mr. Mersereau's findings and recommendations are being studied, and an announcement regarding the first phase of this project will be made in late 1984 or early 1985.

SULPHIDE DEPOSIT STUDY**R.R. Irrinki and G.W. Crouse**

The objective of the project is to carry out a geological evaluation of the following massive sulphide deposits in the order of priority:

1. Stratmat
2. Halfmile Lake
3. Caribou
4. Restigouche
5. Murray Brook
6. Key Anacon
7. Flat Landing Brook
8. Nine Mile Brook

The study includes history and previous work, geology, metal content and distribution and estimation of reserves with a statement of exploration potential. The findings will be presented in a confidential report on each of the above deposits. The report specifically contains the following figures:

- (a) Drill hole location map on a topographic base (preferably surveyed).
- (b) Surface and level plans showing geology and distribution of metals.
- (c) Cross- and longitudinal-sections showing geology and assay data.

The study of the Stratmat deposit started on August 1, 1984 and will be completed by December 31, 1984. Drill hole location map (1"=400'), surface and level plans (1"=100') and cross- and longitudinal-sections (1"=50') are completed on Stratmat East (main zone). Probable and possible reserves and in situ and recoverable copper, lead, zinc and silver contents have also been calculated on the Stratmat East Zone. The study on the Stratmat West and Stratmat Central zones is in progress.

GEOLOGY AND GEOCHEMISTRY**L.R. Fyffe****MIRAMICHI EARTHQUAKE**

The New Brunswick Geological Surveys Branch, Atomic Energy Control Board, Earth Physics Branch and Ontario Hydro have carried out cooperative projects at the site of the 1982 Miramichi earthquake in central New Brunswick.

A 30 m X 100 m area near the epicentre of the earthquake was cleared of overburden and mapped on a scale of 1 cm = 1 m in the fall of 1983. A report was subsequently published on the fracture patterns in the area. At one locality on the new exposure, sheeting in the diorite buckled about one week after the clearing operation. In the spring of 1983, Ontario Hydro drilled six holes in the area, each to a depth of 38 m for in situ stress measurements. Sixty-four overcore tests were made. During the drilling of the two holes at the cleared exposure, a series of rockbursts occurred and two minor tremors were felt. In the fall of 1984, a trench about 1 km in length was excavated to the north of the previously cleared area in order to intersect the postulated west-dipping thrust fault responsible for the earthquake. Several fresh tensional fractures were observed within the granite exposed in the trench (John Adams, Preliminary Report, Earth Physics Branch, 1984).

TROUSERS LAKE AREA

A report on the geology and geochemistry of the Trousers Lake area of central New Brunswick has been completed and sent for external review. Accompanying maps, which have been published previously, are listed below.

M. Crevier (Lac Minerals) and L. Fyffe led a one-day field trip to the area on September 16, 1984 at the request of the New Brunswick Prospectors and Developers Association. Low grade Pb-Zn-Cu-Ag mineralization in a breccia pipe within Devonian volcanic rocks at Mount Costigan and sulphide veins within Devonian granite at Long Lake were examined.

NEW BRUNSWICK-P.E.I. GEOLOGICAL HIGHWAYS MAP

A geological highway map aimed principally at tourists and amateur geologists is being prepared by the Geological Surveys Branch in cooperation with Laing Ferguson and the Atlantic Geoscience Society. At present, the front side has been completed (Provincial geology map showing stop locations - compiled by L. Fyffe) and drafted by Maritime Resource Management Services

(MRMS) in Amherst. Data on site descriptions and panels was collected this summer for the reverse side and is now at MRMS. Final publication is planned for May, 1985. Mineral Resources Division contributors are J. Thibault and A. Seaman (glacial geology), Tim Webb (potash deposits), L. Davies (stratiform sulphide deposits), S. McCutcheon and A.A. Ruitenberg (southern New Brunswick), C. St. Peter (oil and gas deposits), R. Shaw (coal), and L. Fyffe (northern New Brunswick, geological history of province).

GEOCHEMICAL LABORATORY

A total of 260 samples from till (separated sand, silt and clay fractions) collected by A. Seaman and J. Thibault from the Sisson Branch Reservoir and Nepisiguit Lakes map areas were analyzed for Cu, Pb, Zn, Fe, Mn, Ag, Co, Ni, Mo and W. U was determined by neutron activation in Ottawa. Stream sediment samples (2,243) collected from the Edmundston panhandle in 1983 were processed by the same method. Till samples (510) from the Mispec area collected by A. Pronk were analyzed for Cu, Pb, Zn and Ag. Au and As were determined by X-Ray Assay Laboratories in Toronto.

Sixteen standard samples of lake and stream sediments from the Geological Survey of Canada were analyzed (5 times each) to establish laboratory accuracy.

Geochemical data is now handled by computer from a terminal in the geochemistry laboratory. This requires digitizing latitudes and longitudes of sample location points from 1:20,000 scale base maps. Samples are catalogued by class (silt, soil, rock, etc.), age, and bedrock type. Maps can then be generated from the computer file showing sample locations with results and in addition can be treated statistically to show locations of anomalous values. The methods are discussed in detail in Open File Report 84-1 by J. Chandra and G. Crawford. Samples collected in 1982 from the Riley Brook area are now available in this format and 1983 data is now being processed.

PUBLICATIONS

- Fyffe, L.R. 1983. Joint Patterns Within the Epicentral Area of the 1982 Miramichi Earthquake. N.B. Department of Natural Resources Division, Open File Report 83-13.
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- Fyffe, L.R., Forbes, W.H. and Riva, J. 1983. Graptolites From the Benton Area of West-Central New Brunswick and Their Regional Significance. Maritime Sediments and Atlantic Geology, 19, pp. 117-125.
- Fyffe, L.R. 1984. Bedrock Geology of Trousers Lake Area. N.B. Department of Natural Resources Division, Plate 84-22.
- Pronk, A. 1984. Surficial Geology and Related Geomorphological Features of the Trousers Lake Area. N.B. Department of Natural Resources Division, Plate 84-23.
- Pronk, A. 1984. Till Geochemistry of the Trousers Lake Area. N.B. Department of Natural Resources Division, Plate 84-24.
- Pronk, A. 1984. Till Anomalies of the Trousers Lake Area. N.B. Department of Natural Resources Division, Plate 84-25.
- Pronk, A. 1984. Till Pebble Lithology of the Trousers Lake Area. N.B. Department of Natural Resources Division, Plate 84-26.
- Pronk, A. 1984. Till Mineralogy of the Trousers Lake Area. N.B. Department of Natural Resources Division, Plate 84-27.

GEOSCIENCE INFORMATION SERVICES**D.J.J. Carroll**

In 1984, the Geoscience Information Services staff continued the microfilming of all incoming mineral exploration reports and distributed copies of this information to the various libraries in the province.

Indexing of these assessment reports, for entry into the Geological Survey of Canada's GEOSCAN geoscientific bibliographic file, also continued in 1984. Production of an index to the last two years' assessment data will be prepared for distribution at the annual Review of Activities.

In order to expand our GEOSCAN data file, thus providing more available indexes, the Geological Surveys Branch contracted out the indexing of our Division's published reports. To date over 200 of these have been indexed. The coded information remains to be put into the GEOSCAN data base, a task to be completed before the fiscal year end.

Another project carried out this year was compilation of a new list of publications. When completed in early 1985, this publication will provide a comprehensive listing of Mineral Resources Division reports and maps.

The Geological Surveys Branch also carried out prospecting courses in three centres, Saint John, Moncton and Fredericton. A total of 86 students signed up for this ten-session course, bringing the total registration since the course inception to approximately 300. This introductory course was again taught by Mr. W. Lockhart, consultant geologist.

The 1984 prospecting student class also was offered the opportunity to participate in a geological field trip led by Dr. A.A. Ruitenbergh, Regional Geologist for southern New Brunswick. This year's field trip included the Cape Spencer gold prospect and the Annidale copper prospect.

Because of an increase in requests for more detailed discussions on prospecting-related topics, the Geological Surveys Branch will be exploring the possibility of offering an advanced course, either in late 1984 or early 1985.

The year 1984 also represented a period in which the Mineral Resources Division received several requests for the use of existing audiovisual programs and associated materials for use in schools, displays and exhibits, as well as for publication purposes.

In addition to this, the Mineral Resources Division also participated in several public awareness exhibitions by supplying display material along with attendants in some cases. Some of the occasions included the Prospectors and Developers Convention in Toronto, Geological Association of Canada meeting in Ottawa, Belleisle Bay Yacht Club spring exhibition, Moncton's Expo East '84, the Atlantic National Exhibition in Saint John, Albert County Exhibition and Moncton Museum.

During 1984, 142 map plates and 11 reports were released to the public. Publication sales to date are \$12,000.

GRANULAR AGGREGATE RESOURCES OF THE CENTRAL NEW BRUNSWICK LOWLANDS

A.A. Seaman and J.J. Thibault

Under an accelerated granular aggregate inventory program, reconnaissance mapping of previously unmapped portions of the central New Brunswick Lowlands was carried out by A.A. Seaman and J.J. Thibault, with the assistance of two summer students. An area of approximately 13,000 km², comprising all, or parts of, fifteen 1:50,000 scale N.T.S. map areas, was covered (Figure 8). The appropriate map areas are: Grand Lake (21 G/16), Codys (21 H/13), Salisbury (21 I/3), Chipman (21 I/4), Salmon River Road (21 I/5), Harcourt (21 I/6), Buctouche (21 I/7), Richibucto (21 I/10), Rogersville (21 I/11), Kouchibouguac (21 I/14), Pointe-Sapin (21 I/15), Minto (21 J/1), Boiestown (21 J/8), Point Escuminac (21 P/2), and Chatham (21 P/3).

The area is one of generally low relief, underlain principally by flat-lying sandstones and siltstones. The upper few metres of bedrock is commonly weathered, and is used extensively as a source of fill. Due to the lack of hard, well-indurated source lithologies in the area, the quality of the granular aggregate is predominantly poor. However, good quality material is present in a few areas: in portions of the Chatham map area, along the Miramichi River valley near Boiestown, along the Saint John River valley, and in the southeastern portion of the Codys map area, which lies within the Caledonian Highlands.

The major deposits consist of ice-contact stratified drift or of glaciofluvial outwash. The former are exemplified by the subaqueous outwash (subaqueous esker fans) near Gagetown along the Saint John River valley, the kame and kettle complex along the Millstream valley in the Codys map area, and esker systems in the Salmon River Road, Rogersville, and Kouchibouguac map areas. The major outwash deposits occur in the Millstream valley, along the lower Salmon River valley near Chipman, near Boiestown along the Miramichi River valley, and along the Barnaby River valley to the north of Rogersville. Marine shallow-water deposits of sand, and sometimes gravel, are common along the east coast, and around Grand Lake, but are generally shallow.

The final report for the project will present a review of the Quaternary geology of the area, and an assessment of its granular aggregate resource potential. Maps outlining the surficial distribution of the aggregate deposits will accompany the report.

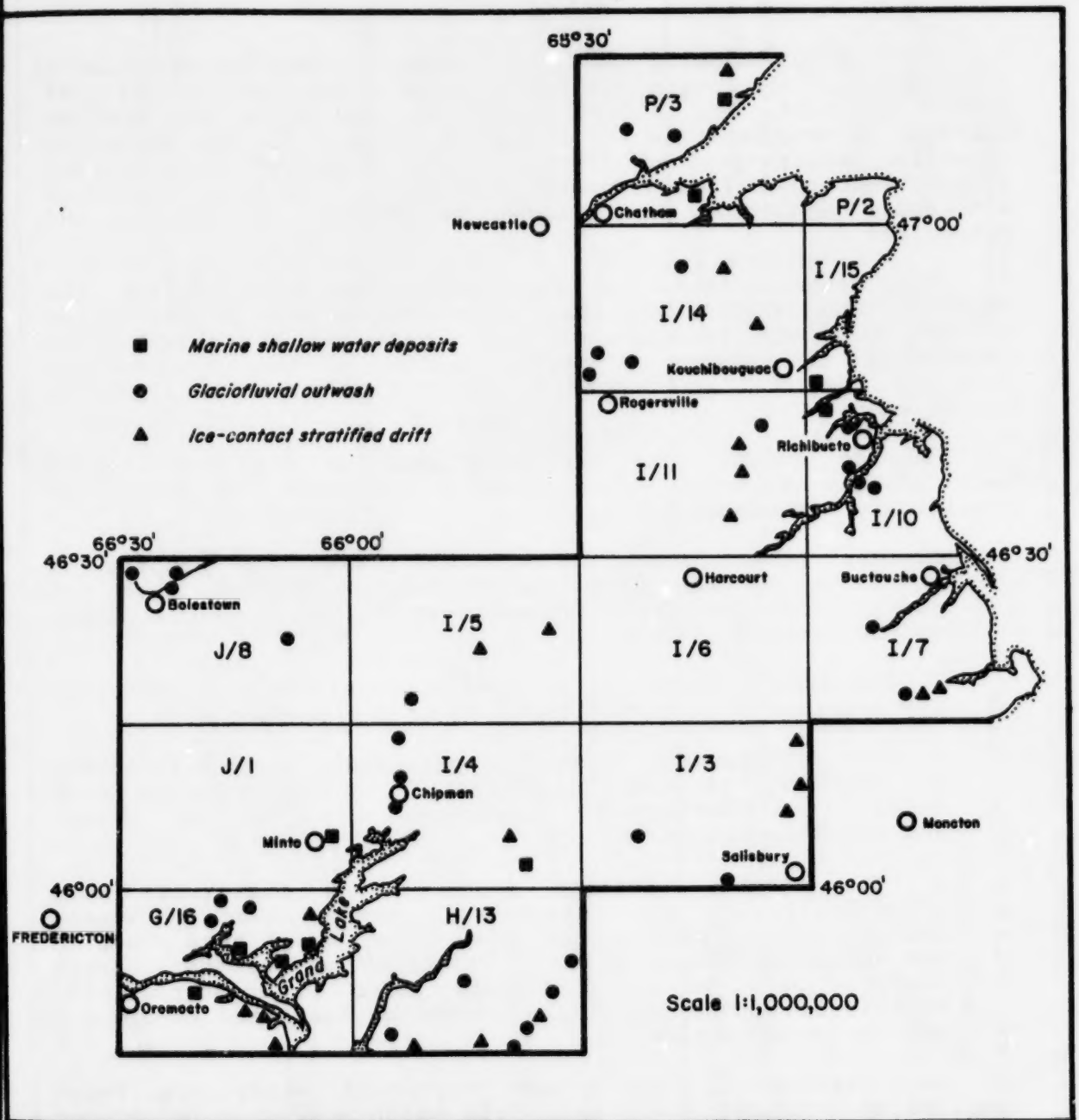


Figure 8. Granular aggregate resources of the Central Carboniferous Basin; significant deposits

ALBERT FORMATION STUDY

Clint St. Peter

Geological mapping of the Lower Carboniferous Albert Formation, which began in 1982, was completed during the summer of 1984. The Albert Formation occurs in the Moncton Subbasin of southeastern New Brunswick (Figure 9). The formation comprises coarse-grained debris flows, coarse-grained braided stream deposits, fining-upward fluvial and deltaic sandstone and shale sequences, and lacustrine shales, oil shales and evaporites.

The central theme of this study has been to map the regional distribution of Albert lithofacies, and in particular to determine the location of high grade oil shale beds. The lacustrine oil shales primarily occur in the southeastern part of the Moncton Subbasin along the northern flank of the Caledonia Uplift.

Mapping during 1984 was undertaken in the southwestern part of the Subbasin, from Hampton northeast to Sussex. A preliminary assessment of the field data indicates that:

1. The Albert Formation between Sussex and Hampton is in fault contact with the Memramcook Formation to the south, and in fault contact with the Hopewell Group to the north.
2. The Albert Formation plunges southwest and is conformably overlain by the Moncton Group in the Hampton area.
3. The Kennebecasis Group, as previously mapped southwest of Hampton, is seen to consist of three different rock units: the Memramcook Formation, the Moncton Group, and the Hopewell Group.
4. The Albert Formation southeast of Sussex is more structurally and stratigraphically complex than previously thought. For example, in the Cedar Camp area, cobble and boulder debris flows - flanking a basement margin fault - were deposited directly into an adjacent lake. In this area, the lacustrine rocks are laminated kerogenous dolomitic oil shales.

The results of the Albert Formation study are being compiled on 1:50,000 scale maps from which a 1"=2 mile geology map of the Moncton Subbasin will be produced.

1. ALCOCK, F.J. and MacKENZIE, G.S. 1946. Geology map of the Sussex area. Geological Survey of Canada, Department of Mines and Resources, Map 845A.

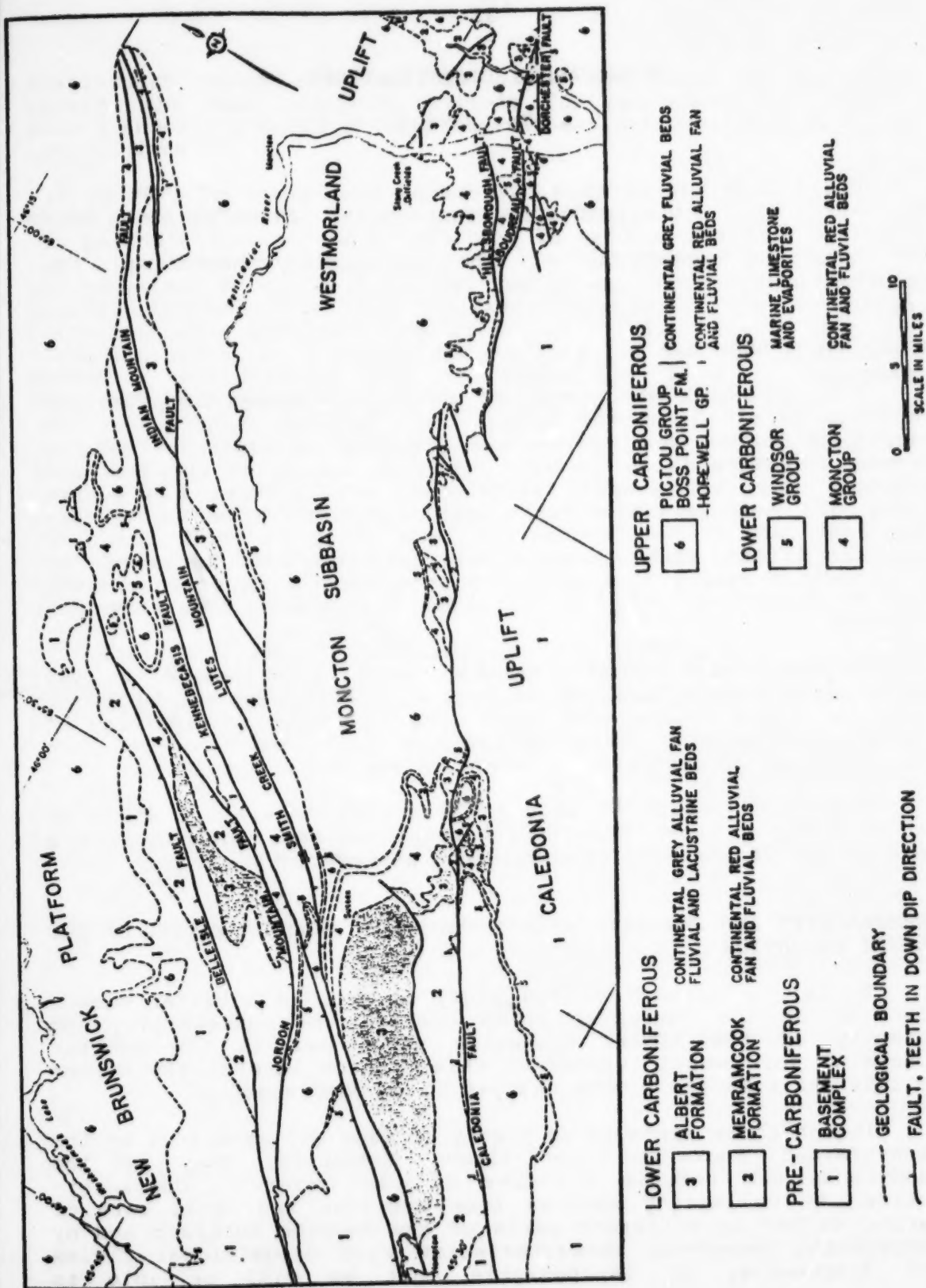


Figure 9. Simplified geology of the Moncton Subbasin.

HYDROCARBON INVESTIGATIONS

A. Tom Martel

Field work was carried out during the summer of 1984 by A. Tom Martel with the aid of a field assistant. Three projects were initiated with the purpose of producing a better understanding of the petroleum potential of the sedimentary basins of New Brunswick.

HYDROCARBON SHOW MAP

A field check was conducted during the summer of petroleum showings recorded in the literature. Earlier authors who had mapped petroleum showings in the province did not distinguish between kerogens (i.e. in situ organics, as in oil shales) and bitumens (i.e. hydrocarbon fluids which were generated by source rocks and have migrated into pore spaces). This is a very important distinction because, while a group of rocks can have abundant kerogen-rich source rocks, the area will be barren of hydrocarbons unless the source rocks have undergone generation. Free hydrocarbons such as bitumens are proof that this has occurred.

It was discovered during the summer, that indeed, a fair number of recorded occurrences were solely kerogen. In spite of this, petroleum impregnated rocks were found over a wide area of the Moncton Subbasin. This implies that petroleum resources have the potential of occurring anywhere in the Basin area.

The final report of this project will consist of a map of the Province's known free hydrocarbon showings together with a description of the mode of occurrence at each location.

PERMEABILITY AND POROSITY RELATIONSHIPS IN VARIOUS FACIES OF THE ALBERT FORMATION

It is the intent of this study to procure a better understanding of the variables which control the permeability and porosity of the Albert Formation sandstones in the Moncton Subbasin. Work was initiated on this project late in the summer of 1984 and some field work has yet to be completed.

Though there seems to be plenty of free oil generated by the fine-grained rocks of the Albert Formation, many of the sandstones are lacking in terms of good reservoir characteristics. By collecting samples from sections and drill core of varied facies in different parts of the Moncton Subbasin and by correlating reservoir characteristics with depositional facies and diagenesis, it is possible that we will be able to

distinguish those areas of the basin and those facies which provide the most promising targets for petroleum exploration. Such a knowledge would greatly benefit explorationists working in the province.

HYDROCARBON POTENTIAL OF THE ESCUMINAC FORMATION

A preliminary field study of the hydrocarbon potential of the Escuminac Formation in Gaspé, Quebec was conducted during the summer. Although the only surface outcrops of the Escuminac Formation occur outside of New Brunswick, it is possible that the formation underlies a portion of the Baie des Chaleurs within New Brunswick jurisdiction and therefore may have an economic significance for the Province.

The Escuminac section in Gaspé consists of a 120 m sequence of turbidites deposited in what is likely a lacustrine environment. Field examination revealed an abundance of well sorted sandstone, especially in the upper third of the section.

Organics are more plentiful in the lower portion of the section and occur in the form of dark organic layers in "varved" or "rhythmite" sediments.

Work is presently underway on the sandstones in order to judge their suitability as reservoir rocks. The fine-grained portion of the section will be studied to discern its value as a source rock.

LIMESTONE INVESTIGATIONS

T.C. Webb

Most of New Brunswick's main resource-based industries are dependent to some degree on a reliable, nearby supply of limestone, dolomite or their products. Although traditionally used as a soil conditioner in agriculture-related practices and as a source of aggregate, it is apparent that over the last 10 or 15 years, limestone, in the form of lime, has become an essential industrial chemical with a formidable list of uses. Indeed, limestone is probably one of the most useful and versatile of all the industrial mineral commodities produced in this province. In the past, the limestone industry has accounted for over 300 jobs for New Brunswickers as well as contributing several million dollars annually to the value of mineral production within the province.

Since the 1965 publication of J.B. Hamilton's "Limestone in New Brunswick" there has been no concerted effort to update information on our provincial limestone resources with the exception of information scattered here and there in various Mineral Resources Division files and reports and in company assessment files. Over the last 19 years, there have been a number of significant developments concerning the province's limestone industry; the expansion of Havelock Lime Works Ltd. into the field of quick and hydrated lime, and the reopening of a quarry at Elmtree in northern New Brunswick are but a few examples. Various exploration programs for limestone have been undertaken both by government and private industry resulting in new occurrences being discovered as well as adding to a plethora of information concerning the evaluation of known deposits.

At this point in time, what is needed is an all encompassing study involving a re-examination and reassessment of the province's limestone resources as well as a report on the state of the industry within the province. A computerized information retrieval system containing important facts on individual deposits is also required. To achieve this, an in-depth literature survey and compilation of existing information on various deposits and occurrences is being undertaken. This has been augmented with field examination involving mapping, sampling and detailed descriptions of individual occurrences. A reference collection, consisting of over 800 hand specimens, chip and channel samples of various exposures throughout the province is in the process of being set up, with the intention of providing a guide to those persons interested in deposits with special chemical or physical properties in specific areas.

In New Brunswick, the majority of our better quality limestones and dolomites are found, principally in rocks of Precam-

brian, Silurian and Mississippian age, although a few occurrences have been recently noted in Ordovician rocks as well. To date, field reconnaissance of most of the main occurrences have been completed and data compilation on individual deposits has been accelerated.

As a result of vast amounts of information available, coupled with that more recently collected, this project has become a fairly massive undertaking. The final report is expected to be completed sometime in 1986. Upon completion, it is the intention that this report will address such issues as the historical development and current status of the province's limestone industry, as well as various geologic aspects of our known deposits and occurrences. It is also intended to investigate various industrial applications of limestone along with specifications for these uses. A review of the current and future supply/demand situation for limestone in Atlantic Canada and the northeastern United States is also expected to be undertaken.

This study, while providing a concise inventory of provincial limestone resources, will hopefully be able to identify new development opportunities for existing and possibly future New Brunswick producers and also act as an important guide, assuring the future protection of our existing, higher quality deposits from the threats of urban expansion. These factors combined should ultimately result in better management of this important resource.

PEAT**R. Shaw**

Since completion of the Peatlands Inventory Project the involvement with peat moss has been directed at resource development. The staff have worked closely with industry, universities and other government agencies to promote peat moss development, peat-derived products and the reclamation of abandoned peatlands.

**VOLCANIC STRATIGRAPHY AND PHYSICAL VOLCANOLOGY OF PART
OF THE DEVONIAN VOLCANIC SEQUENCE, NORTHERN
PASSAMAQUODDY BAY, SOUTHWEST NEW BRUNSWICK**

**Nancy A. Van Wagoner
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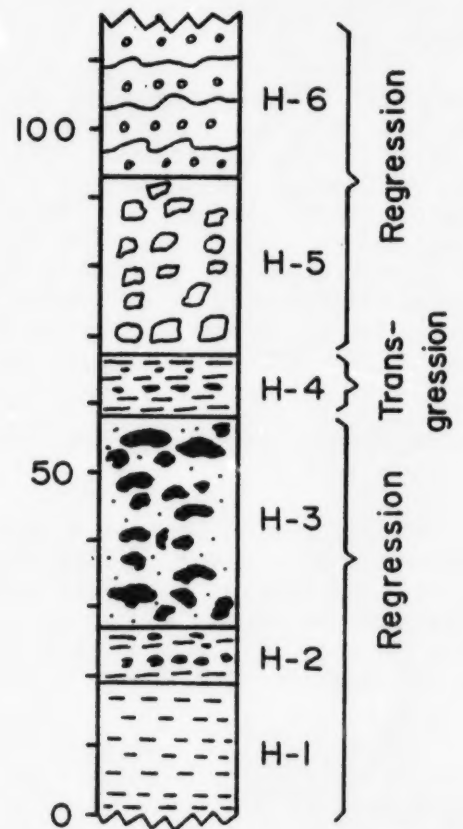
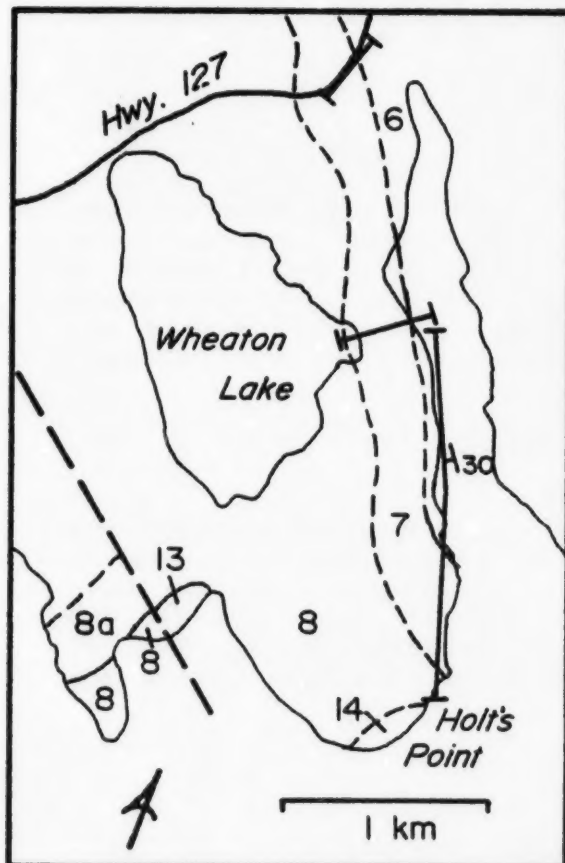
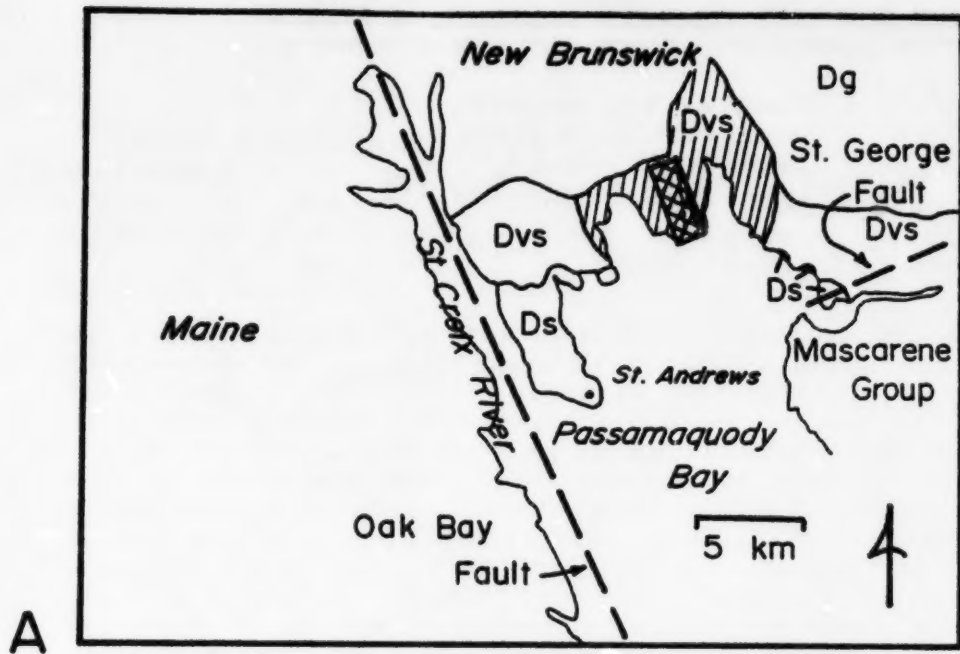
INTRODUCTION

A sequence of Devonian volcanic and sedimentary rocks is exposed along the north coast of Passamaquoddy Bay, southwestern New Brunswick (Pickerill and Pajari, 1976). This sequence of rocks is bordered to the north by Devonian granitoid rocks, to the west by the Oak Bay Fault which bisects the St. Croix River, and to the east by the St. George Fault and the rocks of the Mascarene Group (Fig. 10a). Although these rocks were previously mapped at a scale of 1:31680 by Hay (1967), and at a scale of 1:126720 by Ruitenberg (1968), details of the volcanic stratigraphy and paleovolcanology are unknown. A detailed study of part of this Devonian volcanic sequence was started during August, 1984. This study is the beginning of a long term project to determine the Devonian volcanic stratigraphy, physical volcanology, paleogeography and volcanic evolution of southwest New Brunswick.

This paper presents some preliminary results of field work in the Holts Point area (Fig. 10b) where a transition from clastic tidal facies (unit 6) to terrestrial volcanic and volcanoclastic facies (unit 7) is exposed. Recognition of such transitional facies in the geologic record is important because these facies indicate the position of paleo-sea level and give an indication of how it changed with time. Although other such transition zones have been recognized in Precambrian greenstone belts (e.g. Ayres, 1981 and Van Wagoner, 1983) this facies and variations of this facies are not well documented for volcanic terrains.

**DESCRIPTIVE STRATIGRAPHY AND DEPOSITIONAL ENVIRONMENT OF MAP
UNITS 6 AND 7.**

Three traverses were made through units 6 and 7, covering a distance of about 5 km along strike (Fig. 10b). Exposure is excellent along the Passamaquoddy Bay shoreline, but is only moderate to poor along the shore of Wheaton Lake, and highway 127. The units dip gently to the west exposing about 100 m of stratigraphic thickness along the traverses (Fig. 10c). Rocks are



only weakly metamorphosed, minor faults do not seem to result in major offset, and dikes do not significantly disrupt the stratigraphy. The descriptions below are based on field data. Thin section analyses and analyses of polished and etched slabs are underway.

STRATIGRAPHY OF UNIT 6

Unit H-1: The Tidal Facies

This unit is comprised of brownish red, thinly to thickly bedded mudstone to fine sandstone. The thinner beds are 1-8 cm thick, and are massive, horizontally laminated or ripply cross-laminated mudstone to siltstone. Laminae are approximately 1 mm thick, and distinguished by differential resistance to weathering. Upper surfaces of coarser beds commonly preserve interference current ripples, polygonal mud cracks, rain drop impressions, or rarely, scratch and drag marks.

Approximately 30% of the thin beds contain up to 50% fossils of lingulid brachiopods, bivalves, ostracods, rare gastropods, possible plant impressions, and vertical non-branching tubular burrows, 2-3 mm in diameter. Fossils are mostly concentrated along bedding planes, and are poorly to well preserved primarily as impressions or molds, but rarely replaced or original shell material is preserved. The fauna are described by Pickerill and Pajari (1976).

Figure 10. (a) Location map of study area showing the general geology after Pickerill and Pajari (1976) and Ruitenberg and McCutcheon (1980). The study area is indicated by diagonal lines. The portion of the study area discussed in this report is indicated by the diamond pattern. Dg = Devonian granitoid rocks, Dvs = Devonian volcanic and sedimentary rocks, Ds = undifferentiated Silurian and Devonian rocks. (b) Map of the geology of the Holts Point area after Hay (1967). Bars indicate the location of stratigraphic sections. 6 = brownish red siltstone with minor volcanoclastic layers, 7 = amygdaloidal basalt, agglomerate, and volcanic breccia with minor siltstone beds, 8 = rhyolite flows, welded tuff and agglomerate, brown siltstone, sandstone, and conglomerate, 13 = gabbro, 14 = red sandstone and conglomerate. (c) General stratigraphy of the measured sections. The units are described in the text.

The thicker beds are lense-shaped deposits of siltstone to fine sandstone up to 2 m thick. Lenses are vaguely horizontally laminated, low angle cross-laminated, or ripple cross-laminated. They rarely contain a basal lag gravel approximately 5 cm thick of angular siltstone rip-up clasts up to 3 x 5 cm in size.

This unit is interpreted to represent a higher mudflat tidal facies (Evans, 1965). This is suggested by the occurrence of shallow marine fossils, the fine sediment size, and sedimentary structures such as mudcracks, asymmetrical and interference current ripple marks, and the lack of indication of reworking by waves, which are typical of this facies (Elliott, 1978). The coarser lense-shaped beds are interpreted to be tidal channel deposits in the mud flat. This interpretation is consistent with that of Ruitenberg and McCutcheon (1978) and Pickerill and Pajari (1976) for the same area.

Unit H-2: Tidal Facies with Airfall Lapilli Tuff

This unit is bedded brownish red siltstone as described above with lenses and beds comprised mostly of green volcanic fragments. The abundance of these volcanoclastic layers increases upward in the section from 1% to 90%. The unit also coarsens upward, and bed thickness increases upward from 2mm to 3 cm near the base of the unit to 10 to 30 cm thick near the top. Most layers are lensoidal but irregular in shape, varying in length from 3 to 4 cm to 4 m. The irregular shape is primarily the result of soft sediment deformation. Red siltstone layers contain from 1 to 25% volcanic fragments, and are horizontally laminated, massive or very rarely ripple laminated. Coarse volcanoclastic layers are massive or rarely normally graded. Contacts between siltstone and volcanoclastic layers are gradational over a thickness of 4 mm to 1 cm. The clasts of the volcanoclastic layers are medium sand to pebble sized, angular to rounded in shape, averaging subround, and heterolithic. The following clast types are represented: (1) red siltstone rip-up clasts, (2) dark gray, scoriaceous volcanic fragments, (3) green aphanitic, non-vesicular volcanic fragments, (4) dark gray fine-grained phaneritic volcanic fragments, and (5) red, fine-grained, phaneritic, volcanic fragments. The relative abundance of each clast type is variable from layer to layer. There are rare large vesicular mafic bombs near the top of the unit.

This unit is interpreted to represent a tidal mudflat facies, as unit H-1, which is proximal to an intermittently active volcano(es). The volcanic fragments are interpreted to be airfall deposits because most are too large to have been transported by weak tidal currents. The rare volcanic fragments within the siltstone beds are scoriaceous fragments which were light enough to float or to be transported by tidal currents.

THE STRATIGRAPHY OF UNIT 7

Unit H-3: Mafic Splatter Cone

This unit is a mafic agglomerate. Fragments are ash to bomb sized, and sparsely vesicular to scoriaceous. Bombs are up to 40 cm in long dimension, but rarely up to 1 m long dimension. Bomb size increases upward in the section. The unit is monolithic with the exception of rare (1%) accidental fragments of red or green siltstone. There is no matrix. Ash and lapilli size particles as well as accidental fragments are angular to subangular, whereas, bombs have a smooth rounded upper surface and an irregular bottom surface. Long axes of bombs vaguely define bedding.

This unit is interpreted to represent a splatter cone. Close proximity to the vent is suggested by the large size of some of the bombs and the occurrence of accidental fragments of siltstone suggesting that the volcano erupted through tidal flat deposits.

Unit H-4: Tidal Facies with Airfall Lapilli Tuff

Unit H-4 is interbedded red siltstone and volcanoclastic beds. Volcanoclastic beds are 10-30% of the unit. Beds are 0.5-30 cm thick, but volcanoclastic beds are rarely 1 m thick. Volcanoclastic beds contain 30-90% fine sand to pebble sized, green, angular, scoriaceous and non-vesicular volcanic fragments in a mud matrix. These beds are commonly massive, but rarely normally or reversely graded. Contacts between siltstone and volcanoclastic layers are gradational. Siltstone layers are massive or horizontally laminated. Laminae are 3 mm to 1 cm thick. Siltstone layers contain up to 4% subround, scoriaceous volcanic fragments up to 5 cm in size, but very rarely 30-40 cm in size.

The depositional environment of this unit is interpreted to be the same as that of Unit H-2. Some amount of relative rise in sea level must have occurred after extrusion of the splatter cone deposits so that tidal flat sedimentation could be re-established over the cone.

Unit H-5: Explosion Breccia

This unit is a vaguely bedded volcanic breccia. Bedding is defined by slight changes in clast size and composition, or by variations in matrix content from 10-50%. Beds are 30 cm to 6 m thick. Contacts between beds are gradational. Clasts are up to 1 m in long dimension, averaging 1-2 cm, and are mostly angular to subangular. The types of clasts are: (1) bedded and massive red siltstone, (2) vesicular basalt, (3) non-vesicular basalt, (4) gabbro, and (5) very rare cored bombs, with cores of gabbro,

siltstone, or vesicular basalt contained in a 1-2 cm thick rind of aphanitic basalt. The abundance of siltstone clasts increases upward from 10 to 70%. This unit is divided in two places by a massive red ash layer 10-15 cm thick.

This unit is interpreted to be an explosion breccia which may have formed as the result of explosive interaction of magma with ground water which was able to fragment and eject both the magma and surrounding country rock and sediments. This is suggested by the mixture of abundant siltstone fragments, angular, possibly accidental volcanic fragments, and bombs with cores of accidental fragments.

Unit H-6: Pahoehoe Flows

This unit is a sequence of highly vesicular flows. Flows are 1-2 m thick but flow margins can only be distinguished where the unit is well exposed. Vesicles range from 3-85% of the flows, are up to 1.5 cm in size and round to irregular in shape. The flows contain up to 2% gas cavities up to 40 cm in long dimension and 15 cm in width. Stalactites and stalagmites of basalt protrude into these cavities. Flow contacts are defined by very fine-grained, iron-stained, and undulatory, chill margins, 2-3 cm thick.

These flows are interpreted to be subaerial pahoehoe flows. Although pahoehoe flows form in the deep marine environment (Ballard et al. 1979) the high vesicularity of these flows and lack of evidence of interaction between lava and water indicates that these are subaerial flows. Close proximity to vent areas is indicated by the high vesicularity of the flows which tend to degas with distance from the vent.

SUMMARY

The portions of units 6 and 7 of Hay (1967) in the Holts Point area were deposited near sea level, during a sequence of minor transgressions and regressions (Fig. 1c). Regressions are related to periods of volcanic activity during which volcanoes contributed a large volume of coarse clastic components to the tidal flat sediments. Transgressions seem to be related to brief periods of volcanic quiescence and consequent reduced rates of sedimentation. The occurrence of volcanic breccias and agglomerates indicates volcanism was sometimes explosive in nature which may have been the result of interaction of magma with ground water. Close proximity to vent areas is suggested by the occurrence of agglomerates containing large bombs as well as the high vesicularity of the flows. Lateral variations are difficult to document due to the decrease in quality of the exposure to the north.

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NEW BRUNSWICK RESEARCH AND PRODUCTIVITY COUNCIL

R.S. Salter, Head, Mineral Development and Processing

MINERAL DEVELOPMENT AND PROCESSING ACTIVITIES

The New Brunswick Research and Productivity Council is a contract organization with revenues approximating \$7 million/year for which the provincial government grant represents less than 5 per cent.

The various skills and capabilities of RPC are grouped into ten interdisciplinary units with the Mineral Development and Processing Department being directly responsible for most mineral resource related projects. Energy related projects, such as those involving processing of coal and oil shale, are also carried out by the Applied Science and Engineering Services Departments.

A subsidiary company, Enhanced Recovery Systems Ltd. (ERS), was incorporated during the past year to undertake the general management of the design, construction, and operation of the RPC Sulphation Roast Pilot Plant in Chatham, N.B. The Mineral Development and Processing Department of RPC is responsible for technical management of this piloting venture through a sub-contracting agreement with ERS.

During the past year the more significant projects undertaken by the Mineral Development and Processing group included:

1. RPC Sulphation Roast Process: design and construction of the Chatham Pilot Plant.
2. Oil Shale, enhanced oil recovery by hydrotreating.
3. Enhanced silver recovery for Brunswick Mining and Smelting.
4. Mineral study for Avino S.A. de C.V., Mexico.
5. Mineralogy and metallurgical investigations for Mount Pleasant Tungsten.
6. Pyrohydrolysis of low level radioactive wastes: construction and commissioning of a demonstration unit for AECL.
7. Metallurgical consulting to Durham Resources Ltd.

8. Coal mineralogy studies for National Research Council.
9. Mineralogy of Cape Spencer gold carriers for Department of Natural Resources.
10. Mineralogy of slags from Dalhousie Coal Fired Thermal Station for National Research Council.
11. Geochemical, Inorganic Analytical, Industrial Chemistry, and Occupational Health and Safety services and consultation.

**UNIVERSITY OF NEW BRUNSWICK
DEPARTMENT OF SURVEYING ENGINEERING**

A. Chrzanowski and A.C. Hamilton (Chairman)

In relation to the needs of the mining industry and mineral exploration, the Department of Surveying Engineering at the University of New Brunswick offers unique specialization in mining surveying and rock deformation measurements at the B.Sc.E., M.Sc.E. and Ph.D. levels. Remote sensing, digital mapping and development of land information systems are other areas of specialization which are directly applicable to the mining industry and to the evaluation of mineral resources.

The Department, with its 160 undergraduate and over 40 post-graduate students, is heavily involved in research activities. This is reflected by a large external funding for research which exceeded \$750,000 in 1983/84.

Recent research activity has included the following projects:

- i) development of a telemetry system for monitoring ground movements in mining areas;
- ii) use of the finite element method in modelling mining subsidence;
- iii) development of new laser instruments for engineering and mining surveys;
- iv) application of photogrammetry in monitoring mining subsidence;
- v) monitoring of tectonic movements in the earthquake area of northern New Brunswick;
- vi) monitoring of surface deformations in oil fields in Venezuela;
- vii) application of digital mapping in the geosciences and modelling of mines;
- viii) use of satellite imagery in identifying geological structures in New Brunswick;

ix) development of a generalized approach to the analysis of deformation surveys.

Brief reports on some of the above topics follow.

Development of a Telemetry System for Monitoring Ground Movements in Mining Areas

A. Chrzanowski, B. Kurz, W. Faig and Makosinski

A group of faculty members of the Surveying Engineering Department in cooperation with Computer Science and Physics have recently developed and constructed a telemetry system for continuous monitoring of ground movements in difficult topographic and climatic conditions. The project was undertaken at the request of the Canada Centre for Mineral and Energy Technology to monitor ground subsidence in coal mining areas in Western Canada.

The developed monitoring system is based on the concept of measuring ground tilts with electronic tiltmeters at selected points above the exploitation area. The mechanical tilts are then transformed into electric signals which in turn are changed into radio frequency signals and transmitted to a master receiver unit located a few kilometres from the site.

The system consists of "Slave" units which are directly linked with the tilt sensors and a "Master" unit which serves as a controller and handles the acquisition of sensor data from the Slaves as well as providing data storage and data analysis capabilities. A small computer from which the slave station can be interrogated at any time is located at the master station. It can be hooked up to the public telephone network, and therefore, to any large computer at any location across the country.

Each Slave monitors one biaxial tiltmeter (two inclinations) and temperature. It also sends information on the voltages of the batteries. The system can accommodate up to 256 Slaves. Each Slave can monitor up to four data points (sensors). Any type of sensor producing electric output can be hooked up to the telemetry system. Thus the system can be utilized in many other applications, not only in the study of subsidence.

The system was designed and constructed so that it can turn itself off after it has been interrogated by the master station. This ensures that the unit's power base (gelcells) lasts over the winter when access to the instruments is impossible. The frequency of automatic interrogations can be pre-programmed for any desired time interval. The power supply was designed to survive one year without recharging the batteries when applying two interrogations per day.

Modelling of Mining Subsidence Using the Finite Element Method

A. Chrzanowski and A. Szostak-Chrzanowski

The Department of Surveying Engineering, besides developing the instrumentation for monitoring ground movements, is also involved in a study on predicting the ground subsidence in mining area.

A computer programme for a 2-D and 3-D finite element method has recently been developed and implemented in a study of surface subsidence produced by extraction of a steeply inclined coal seam in difficult geological and topographical conditions of the Canadian Rocky Mountains. Actual displacements obtained from geodetic surveys and from the aforementioned telemetric tilt measurements have been compared with the predicted values obtained from empirical modelling using Budryk-Knothe's theory and from a deterministic model using the finite element method. The FEM approach, despite uncertainties in the geological input data, indicated obvious advantages over the empirical model.

A good agreement was obtained between the FEM results and the observed displacements on the surface. The FEM methods allowed introducing into the analysis the influence of the geological faults which could not be modelled when using the empirical approaches.

The research in the use of the finite element method in the subsidence studies continues.

Application of Digital Mapping in the Geosciences and Modelling of Mines

S. Masry and M. Kavouras

In the field of Digital Mapping, the Department of Surveying Engineering has been involved in a number of geoscientific applications. The rapid development of digital mapping systems has made it more practical for geophysicists, geochemists, and recently geologists, to store, share, retrieve, update, manipulate and display their information efficiently.

The Department of Surveying Engineering also houses the digital mapping system CARIS (Computer Aided Resource Information System). The system has been adopted by the Land Registration and Information Services (LRIS), to digitally produce all topographic base maps for the Maritimes. Availability of such maps is the first step in making digital mapping of geoscientific data practical. The Mineral Resources Division of the New Brunswick Department of Natural Resources has completed a feasibility project using CARIS to handle geoscientific data.

The current research has been directed towards the design of a three-dimensional geometric modelling system for mining applications. This system will relate information about the location and the form of the ore body, its mineral content and the mechanical characteristics of the surrounding rocks, to information pertaining to tunnels, excavations and utilities. The ability to automatically apply various evaluation procedures as the information is updated, will optimize the mine design, tying together two professionally separate areas: that of geology and that of mine engineering.

Use of Satellite Imagery for Identifying Geological Structures in New Brunswick

E. Derenyi and R. Yazdani

The objective of this project was to ascertain the utility of the Landsat multispectral scanner (MSS) for identifying geological structures in New Brunswick and to establish the most

suitable methodology for this purpose. A 5400 km² area centred around Mount Pleasant mine was the site of the study. The investigation was carried out in the Dipix Systems ARIES-II digital image analysis system of the Department of Surveying Engineering.

First the data was geometrically corrected and registered on the UTM map projection grid on which the geological maps of the Province are based. The size of the ground resolution element (pixel) was also changed to 50 m. Thereafter, various image enhancement techniques were applied to facilitate the interpretation, such as:

- unsupervised classification to aid texture analysis;
- contrast stretch and colour balancing to emphasize tonal differences; and
- a band 7/5 biomass ratio processed through a high-pass filter to enhance the linear structures.

Finally, a principal component transformation was performed on the enhanced data.

The results indicate that a piece-wise contrast stretch on the three axes of the principal component enhancement, namely brightness, red-green and blue-yellow, coupled with colour balancing is the most suitable technique for facilitating the identification of geological structures.

This study was performed in collaboration with the Geological Surveys Branch of the Mineral Resources Division.

**REPORT OF ACTIVITY
DEPARTMENT OF GEOLOGY
UNIVERSITY OF NEW BRUNSWICK**

**BY
P.F. WILLIAMS**

1983-84 has been a successful year and a bumper year for graduations; 19 students graduated with a B.Sc., 6 of them with honours; 12 graduated with an M.Sc. and 3 with a Ph.D. It was the best year ever. Once again we succeeded in publishing between 40 and 50 articles and abstracts and were successful in obtaining support from NSERC and other sources. We received a total of \$60,214 in equipment grants from NSERC; \$8,745 for an XRF tube (Dr. N.J. Susak) and \$51,469 for a Hydrothermal Solubility System (Dr. N.J. Susak) and a further \$62,961 from MPHEC. Much of the latter (\$32,439) was for purchase of a Logitech Polishing System, thus completing re-equipment of our thin section and polished specimen facility. The remaining money from MPHEC comprised \$10,000 for a portable proton magnetometer, \$14,000 for six binocular microscopes and \$5,745 for AA lamps. Additional support was received from UNB Research Fund, EMR, Brunswick Mining & Smelting, Heath Steele Mines Ltd., Seabright Resources Inc., DNR, CIMM, Chevron, Riocanex, Consolidated Rambler and others.

Student numbers decreased a little after last years all-time high. Undergraduate numbers for 84/85 are down 17% although this drop will probably decrease when registrations are completed for second term. The number of resident graduate students increased from 20 to 22 with 13 M.Sc. and 9 Ph.D. students. The number of non-resident students decreased significantly from 18 to 6 as a large number of long standing students finally completed their degrees. Of the present graduate students 11 are working on projects in New Brunswick and 7 are working on economic projects.

Geological Engineering continued to be popular with a total enrollment of 64, spread over all years. The program passed an important milestone this year in June when it was accredited by the Canadian Accreditation Board.

There were significant changes in the faculty this year with the retirement of Dr. A.L. McAllister. Arnie, probably the best known member of the Department, has been teaching at UNB for 32 years and was Head of Department for 11 years. He took early retirement this year but is continuing to work on a 6 month per year contract until 1987. At a recent Departmental party in his honour he said that he has altered the contract to read until 1989 - so we look forward to having him around for a few years yet.

Dr. Gordon Watson joined the faculty this year in a temporary position and hopefully will stay with us at least another 6 months. He has taken over teaching vacancies resulting from Dr. McAllister's reduced commitment. We have had one P.D.F. this year, Dr. C. Mawer, who continues to work on rock deformation problems. We are presently looking for a metamorphic petrologist for a tenure track position.

In common with many local geologists, members of the Department are becoming increasingly busy with preparations for the GAC/MAC meeting "Fredericton '85". Preparations are progressing well and the second circular will have been sent out by the time this report goes to press.

The various projects in progress during the past year are listed below under discipline headings.

REGIONAL MAPPING PROJECTS

Several members of the Department continue to be active in regional studies. R.H. Grant is continuing with his studies of Variscan tectonics west of Saint John and hopes to publish his map next year. Dr. R.K. Pickerill, in collaboration with Dr. K.L. Currie of G.S.C., Dr. D. Nance of the University of Ohio and a graduate student, is involved in regional mapping in the Saint John area (N.B.). I. Patel is working on the Precambrian - Cambrian boundary in New Brunswick. Dr. J.P.A. Noble is continuing his regional stratigraphic studies of the Silurian-Devonian of northern N.B.

Dr. P. Stringer and Dr. K.B.S. Burke are combining geological and geophysical mapping to trace the extent of Lower Jurassic (K/Ar dating 1983) dykes in the St. Andrews - St. George area (N.B.) and have distinguished pre- and post-Lower Jurassic displacements on major strike-slip faults.

Dr. H.W. van de Poll, I. Patel and graduate students are continuing mapping and basin analysis of Carboniferous and Lower Permian Strata in eastern Canada and have specific project areas at present, around Tatamagouche, N.S., Parrsboro (N.S.), Tynemouth Creek (N.B.), the Sydney Basin (N.S.) and on Prince Edward Island. In addition, Dr. van de Poll has begun a study of sedimentary structures in the Kingsclear Group exposed along the TCH, west of Fredericton.

Dr. P.F. Williams together with postgraduate students continues mapping in the Dunnage Zone around eastern Notre Dame Bay (NFLD). Mapping is being carried out at various scales from 1:12,500 to 1:100 and results are being compiled at 1:50,000. A new Twillingate 1:50,000 sheet is planned for next year.

ECONOMIC DEPOSITS AND MINERALIZATION

The Department continues to be active in the economic geology field. Dr. A.L. McAllister has several projects in progress. His research continues to emphasize the general characteristics of mineral deposits and their environment. Current projects within the Atlantic Provinces are mainly centered upon Rambler, Key Anacon and Heath Steele, all massive volcanogenic deposits. One project is oriented toward the geochemical detection of weather-resistant mineralization. Projects being carried on by students outside the Atlantic Provinces include uranium occurrences in the Bancroft area and mineralization in the Adirondacks. Dr. D.J. Bachinski has just returned from sabbatical in Australia. He and his graduate students continue work on massive sulphide occurrences in the Canadian Appalachians with detailed studies on Fe-Cu-Zn deposits in the Fossner's Group and in Newfoundland. Results of the Fossner Group work will be presented at the Poster session in Fredericton. A graduate student project on hydrodynamic models and hydrothermal ore deposits in sedimentary environments has been conducted during the past year. This work focused on artesian models.

Dr. W.E. Hale has supervised a D.N.R.- and Shell-supported study of uranium and thorium distribution in rocks of southwest New Brunswick and that project is now completed. His work on gold in Nova Scotia, involving a graduate student, is continuing and studies are being made of vein and offshore placer deposits as well as old tailings.

Dr. P.F. Williams and Dr. D.J. Bachinski continue supervision of Cees van Staal's project in the area of Brunswick #6 and #12 Mines and Austin Brook. The work indicates that the economic mineralization is controlled by F2 folding and much of the mineralization seems to have been remobilized during deformation though it may not have moved very far. The thesis is presently being typed.

Dr. H.W. van de Poll continues his interest in the economic geology of the Permo-Carboniferous of N.B., N.S. and P.E.I. with emphasis on the lithostratigraphy, sedimentology and paleoclimatic evolution of coal basins and the Prince Edward Island redbeds for an overall evaluation of their economic potential with respect to coal, gravel, copper, uranium and natural gas.

Dr. R.K. Pickerill is continuing supervision of a D.N.R.-sponsored graduate project on the Albert Formation. The project involves detailed mapping, stratigraphy and sedimentology and is concerned with delineating the areal distribution of the oil shales. The thesis is almost complete.

GEOCHEMISTRY

Dr. N.J. Susak has begun a program in experimental geochemistry. Initial work is focused on the structure and coordination of transition metal complex ions in ore-forming solutions. This is determined by optical absorption spectrometry. The role of coordination changes on mineral solvation mechanisms and kinetics is also being investigated.

GEOPHYSICS

Dr. K.B.S. Burke is continuing studies of seismicity in New Brunswick. A study of the historical seismicity of the Province has commenced using the records available in the UNB and other library collections in the Province. So far, 18 new 'events' that were not previously listed in earthquake catalogues have been found. In addition, an assessment of the more comprehensive sets of intensity data obtained in this study has led to the relocation of the 1869 and 1937 earthquakes, previously reported as having epicentres in southern New Brunswick, to more central and northerly positions.

PALAEONTOLOGY

Dr. A. Logan is continuing actuopalaeontological studies of modern hard substrate communities in the Bay of Fundy with a view to ascertaining their value for palaeoecological reconstruction in the Mesozoic. He is also working on competitive interactions of hermatypic corals in Bermuda and their significance in terms of distribution and succession of similar species in Tertiary and Pleistocene reefs. Dr. J.P.A. Noble together with graduate students continues his studies of Palaeozoic fossil assemblages with emphasis on Silurian corals and stromatoporoids.

Dr. R.K. Pickerill, who this year was elected Chairman of the Trace Fossil Research Group of the S.E.P.M., is continuing work on the structure, composition, ecology and evolution of Silurian (Llandovery) brachiopod dominated communities of Arisaig (N.S.) with Dr. J.M. Hurst. Additionally, he is making a study of the structure, composition and evolution of Ordovician marine benthic communities in Quebec with Dr. T.L. Harland and in Wales with Dr. P.J. Brenchley. He is also collaborating with Dr. M. Wade of the Queensland Museum, Australia, in a study of Cambrian jellyfish from the Saint John area. He continues his extensive trace fossil research in Spain, Portugal, Quebec, Newfoundland, New Brunswick and Alaska and is now initiating a similar project in Oregon.

PETROLOGY

Dr. S.W. Bachinski, currently on sabbatical leave, is working on the geochemistry, mineralogy and petrology of lamprophyres from New Brunswick and elsewhere and Dr. L.T. Trembath is studying crystallization of feldspar in synthetic and natural systems. This latter project is concerned with a comparison of microstructure in natural and experimentally produced, compositionally equivalent crystalline material and is aimed at developing a better understanding of the crystallization and emplacement of granitoids.

SEDIMENTOLOGY

Dr. J.P.A. Noble is continuing with stratigraphic and sedimentary studies, including a study of diagenesis, in northern New Brunswick and Gaspé as part of a Silurian-Devonian Appalachian basin project.

I. Patel is continuing a study of the sedimentology of the early Lower Cambrian, Ratcliffe Brook Formation in southeastern New Brunswick and is attempting correlation with similar sequences in parts of the northern Appalachians and Europe.

Dr. R.K. Pickerill is contributing sedimentological work to a regional study of the Saint John Group, as mentioned above, and a Ph.D. student is in the initial stages of writing his thesis.

In addition to the obvious sedimentological bias of their regional project mentioned above, Dr. H.W. van de Poll and I. Patel are continuing work on physical diagenesis. They are augmenting this study with laboratory tank experiments, by means of which they are replicating many of the structures observed in the field. This work has implications for petroleum reservoir studies and metallagenesis of certain low temperature, sediment-hosted mineral deposits.

STRUCTURAL GEOLOGY

Dr. P. Stringer is continuing structural mapping in the Oak Bay area, St. Stephen (N.B.). He is also working in the Fieldings Cove area of southern N.B. on the supposed Triassic Lepreau Formation. His work there indicates intense deformation correlative with the Hercynian (Carboniferous) orogeny. Samples of cleaved shales submitted to the G.S.C. have yielded a Lower Carboniferous palynological age.

Dr. J.C. White has set up a laboratory for preparation of transmission electron microscopy specimens and is continuing electron microscopy studies of fault materials with a view to characterizing the deformation mechanisms. He has an on-going project on the Cobequid Fault Zone in the Parrsboro area (N.S.) and on its possible extensions in N.B. In the coming summer, a program in conjunction with the Geological Survey of Canada to study faulting in the Pictou Basin will be initiated. Mapping and textural analysis of shear zones in the Grenville of Ontario is also being carried out.

Drs. C. Mawer and P.F. Williams completed a microstructural investigation of rocks from the Miramichi earthquake epicentral area and demonstrated a long history of increasingly brittle deformation. They have also completed a microstructural study of rocks from the vicinity of the Chedabucto Fault and a theoretical study of heterogeneous deformation in shear zones.

Dr. Williams and Dr. G.P. Price of CSIRO, Australia completed the first part of building a semi-automated fabric stage for rapid fabric analysis. The facility can now measure quartz fabrics in suitable rocks. It is also set up to do calcite fabrics and will be tested as soon as suitable ultra thin sections are prepared. Dr. Williams is continuing development of the facility to handle other minerals and to produce AVA diagrams. Dr. Williams also has a microstructural study in progress, in collaboration with Dr. Janos Urai of State University of New York, Albany, U.S.A., on quartz and calcite veins from Squashberry Island in Notre Dame Bay.

